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OSTEOCHONDRITIS OF THE GROWTH CENTERS

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THE purposes of this paper are (1) to assemble a review of the literature concerning a disease common to all the centers of ossification of the human skeleton, (2) to simplify and standardize the terminology of this disease, and (3) to present its occurrence in a family of four individuals.

The literature on this subject is voluminous and confusing. Since the first report in 1903 (Osgood), there has appeared a bibliography of about seven hundred articles. The existing muddle has largely resulted from three major causes: (1) failure to recognize the etiological factor producing the disease, (2) the multiplicity of terms used to describe the same type of pathology in the various ossification centers of the body, and (3) a paucity of pathological material for study.

A review of the literature concerning this subject impresses one with the great variety of terms used to describe what is apparently the same disease. In no other disease of bone is there such a plethora of terminology. If this subject is so perplexing to one who has grown up with the literature, imagine what a difficult situation it must be for the medical student who attempts an understanding of the disease. It is unfortunate that through either indifference or vanity, physicians have allowed their names to be used as diagnostic terms in the various locations throughout the skeleton where this condition occurs. This has resulted in an irregularity of terminology which has added much confusion to that which always occurs when etiology is unknown.

The term "epiphysis" is derived from the Greek word ἐπίφυσις, meaning one that grows to another; it is said to have been a familiar word to Hippocrates. Various authors, including Realdus Colombus (1559), Morgagni, Ambrose Paré, and many others, wrote of epiphyseal separation. John Hunter was the first to prove experimentally that long bones grow in length from the epiphyses. John Poland's book, *Traumatic Separation of the Epiphyses*, published in 1898, was probably the most thorough discussion of the subject known at that time. In many ways it has not been improved upon even to the present, although modern X-ray equipment has yielded important additional observations. The earlier writers were concerned chiefly with traumatic separation of the epiphyses. The paper by Osgood in 1903, concerning the tubercle of the tibia, was the first attempt to describe a non-traumatic type of epiphyseal disease. Schlatter gave an account of the same condition in 1908. Koehler (1908) wrote of changes in the tarsal scaphoid and patella. Several years later (1910) Legg, Calvé, and Perthes described a similar disease involving the epiphysis of the head of the femur. Sever also described the same process in the os calcis in 1912, and Freiberg drew attention to it in the head of the second metatarsal in 1914.

Finally, in 1921, Scheuermann reported a similar condition in the epiphyses of the vertebra.

Gradually it became apparent that all these conditions, known by the names of the authors describing them, were very closely related. The custom of applying authors' names to the disease, rather than thinking of it as a pathological entity which might involve any growing ossification center, undoubtedly masked for a long time the fact that all of these lesions were the same process showing similar characteristics in their onset and progress. Thus, the disease entity, osteochondritis, was but slowly recognized.

ANATOMICAL CONSIDERATION

When the surgeon is called upon for his opinion respecting the nature of injuries occurring in the vicinity of the larger joints in early life he will find a knowledge of the anatomy of the epiphyses of the greatest importance. (Professor R. W. Smith.)

In the majority of cases bone is made of cartilage formed in mesodermal tissue. The first step is a closer aggregation of the mesodermal cells in the location where the model of the bone is to be made. This aggregation of cells assumes an appearance intermediate between fibrous tissue and cartilage, forming a substance called procartilage, which is gradually transformed into hyaline cartilage.

The process of ossification commences at different dates in different bones, but the date is fairly constant for any one bone in different subjects. By the second month of intrauterine life, ossification has started in nearly all the bones. The point in the bone where ossification begins is called a center of ossification and the center is said to appear at such and such a date. Many of the bones are ossified from more than one center. When a bone has several centers of ossification and the centers appear at widely separated dates, the first to appear is called the primary center and the others are called secondary centers. The largest part of the bone is ossified from the primary center.

Some short bones and some flat bones are ossified entirely from the primary center of ossification, for example, the cubical bones of the wrist and ankle except the calcaneus and rarely the accessory scaphoid. All the long bones and many others acquire secondary centers of ossification that appear in outlying cartilaginous parts into which ossification from the primary center has not had time to extend. Nearly all the secondary centers appear after birth and the method of ossification from them is the same as from the primary center. Many of the secondary centers do not appear until later; many appear near the time of puberty, for example, in the spine, tibial tubercle, pelvic girdle, ribs, clavicle, and rarely the patella.

The part of a bone ossified from the primary center is called the diaphysis; the part ossified from the secondary is called an epiphysis.

Every long bone has an epiphysis at one end; most of them have epiphyses at both ends. In some bones there are more than one epiphyses at the end, for example, the distal end of the humerus and the proximal end of the femur. Metacarpals, metatarsals, phalanges of feet and hands, as well as clavicle, are examples of bones with epiphyses at one end. In case the larger epiphyses are ossified from more than one center, the parts ossified from these separate centers coalesce before union with the diaphysis, for example, the proximal end of the humerus. When there are more than one epiphyseal centers at the end of bone and the parts ossified from these centers do not coalesce but join the shafts separately, each part is called an epiphysis, for example, the parts at the proximal end of the femur.

It is to be remembered as Poland points out that:

> ..the boundary line between the epiphysis and diaphysis alters its relationship very considerably with regard both to those parts, to the neighboring joint, and to other surrounding structures. Marked examples of this may be seen at the lower end of the humerus and the upper end of the femur. In the latter the whole upper extremity in infancy comprises the head, neck, and greater and lesser trochanters in one cartilaginous mass, but as age advances, the head and trochanters form separate epiphyses by the upward growth of the neck from the diaphysis.
>
> Not only do the individual epiphyses alter their relationship with the corresponding diaphyses during the different stages of their development, but the same epiphysis will have a very different anatomical appearance at different periods—e.g., during infancy and during adolescence—at one time forming a relatively large portion of the end of the bone, and

at another time forming a small one, as at the upper end of the humerus. . . .

The epiphyses of the long bones in children do not comprise the whole of the end of the bone as seen in the adult, but only about two-thirds, the remaining third (e.g., the lower end of the humerus) being formed by the diaphysis (Cruveilhier). . . .

The epiphyses, when fully formed, are somewhat similar in structure to the short bones of the body, being composed of spongy cancellous tissue, arranged in a definite and distinct mechanical manner and surrounded by a thin layer of compact bone. Their diaphysial surface is not smooth but covered with small mammillary projections and pits which accurately fit corresponding depressions and ridges on the end of the diaphysis, strengthening the union between the epiphysis and diaphysis. On the diaphysial ends of some of the long bones, as at the lower end of the tibia, these ridges and elevations are arranged in a very definite manner.

The epiphyses at the two ends of the diaphysis of the long bones at the period of maturity freely communicate by means of openings into the medullary canal, the alveoli of the spongy epiphysial tissue at this period passing into those of the diaphysis.

It is only in rickets and some other pathological conditions that the cartilaginous line is penetrated by blood vessels; the epiphysial cartilage, small though it may be, will in the normal state completely shut off the alveolar spaces of the epiphysis from those of the diaphysis.

The epiphyses obtain their blood supply from the periosteal network of arteries, large branches of which perforate the thin layer of compact tissue on their exterior, and are distributed throughout the spongy cancellous tissue. Nearly the whole of the blood supply is therefore independent of the diaphysis. Only one or two minute arteries pass into the epiphyses from the diaphyses through the conjugal cartilage. This accounts for the comparatively infrequent occurrence of necrosis of the epiphysis in traumatic separation of the epiphysis even when the diaphysis is more or less completely displaced from off the epiphysis.

CLASSIFICATION AND TERMINOLOGY

We would classify the types of osteochondritis under discussion into either the primary or secondary groups, depending upon whether the primary center of ossification or the secondary center is first involved. The time of appearance and ossification of these centers is represented in the diagrams (Fig. 1). Osteochondritis develops in ossification centers during the period of growth from one or both centers. This classification immediately places all the cubical bones of the wrist and the feet, except the calcaneus, into the primary group (Table I). In the spine both the primary and secondary types have been described. The growth centers in the spine develop rather late and have two periods of active growth; the first involves the primary centers during the first decade, and the second the secondary centers during the second decade. A primary type may continue until the appearance of the secondary centers, or both types may appear simultaneously in the same patient.

TABLE I.—OSTEOCHONDRITIS OF THE GROWTH CENTERS

A. Primary osteochondritis (involvement of primary centers of ossification)
   1. Spine (before puberty)*
   2. Patella (before puberty)*
   3. Ribs (before puberty)*
   4. Clavicle (before puberty)*
   5. Pelvic girdle (before puberty)*
   6. Cubical bones of ankle, except calcaneus and rarely accessory scaphoid
   7. Mandible
   8. Sternum
   9. Cubical bones of wrist

B. Secondary osteochondritis (involvement of secondary centers of ossification or epiphyses)
   1. Spine (at puberty)*
   2. Ribs (at puberty)*
   3. Clavicle (after puberty)*
   4. Patella (at puberty)*
   5. Pelvic girdle (at puberty)*
   6. Femur
   7. Tibia
   8. Fibula
   9. Calcaneus
   10. Metatarsals
   11. Phalanges
   12. Scapula
   13. Humerus
   14. Ulna
   15. Radius
   16. Metacarpals

*These bones have primary and secondary centers of ossification developing at widely separated periods.

Secondary osteochondritis of the head of the femur, also known as Legg's disease, Legg-Perthes' disease, Perthes' disease, Legg-Calvé-Perthes' disease, Calvé-Waldenström-Legg-Perthes' disease, osteochondritis coxæ juvenilis, osteochondritis deformans, osteochondritis deformans juvenilis, coxa plana, pseudocoxalgia, osteochondritis of the hip joint, or osteochondral trophapathy of the hip joint, is one of the most common of this group. It usually occurs in very active, well developed boys between the ages of 3 and 12 years, although girls are not exempt. The first symptom is a limp on the affected side, and this may be accompanied by local pain and

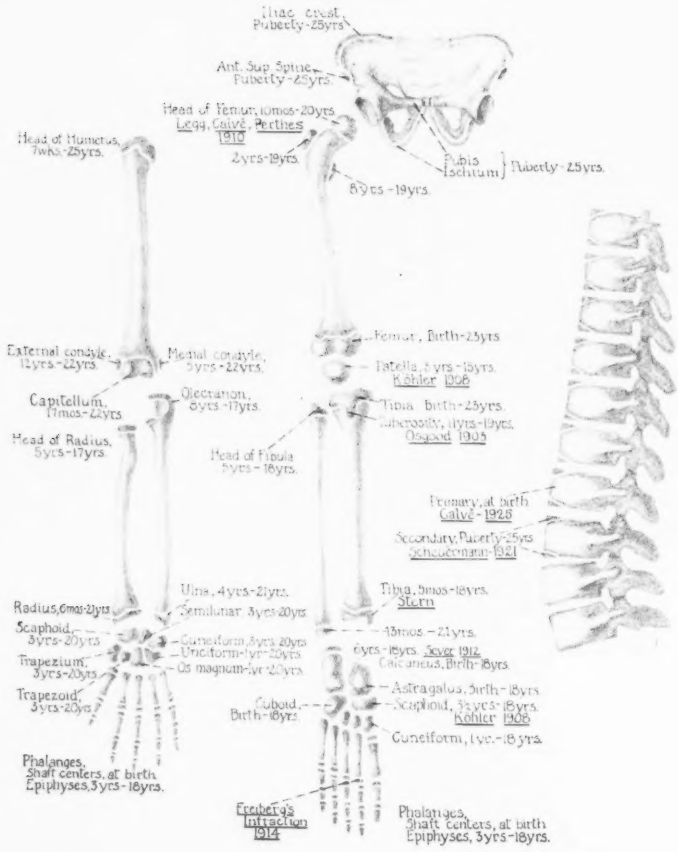

Fig. 1. Drawing of the ossification centers with the ages of appearance and final ossification, with dates when the diseases were first described, and authors who first reported them.

tenderness. A certain number of patients give a history of trauma. Osteochondritis (secondary) of the capital epiphysis is also common after reduction of congenital dislocation of the hip. In the early stages, examination and roentgenograms will probably be negative, but in the course of a few weeks some wasting of the gluteal muscles on the affected side can be seen. Some general muscle spasm, as well as pain and tenderness, may be elicited. Abduction and internal rotation are slightly limited. The Trendelenburg sign is present.

Roentgenograms taken at this stage are characteristic. The ossification center of the epiphyseal head shows areas of rarefaction. Later it is flattened and fragmented into several pieces. The neck of the femur is thickened and shortened; the thickening is greatest near the epiphyseal line. In a few cases the acetabulum may be flattened. The resulting deformity of the head of the femur may be classed as either the cap or mushroom type. Legg calls attention to the different clinical courses which both types may run. In the mushroom type the chief complaint is

Fig. 2. Case 1. There is considerable mottling of the neck of the right femur with some flattening of the right and left capital epiphyses. Roentgenogram taken 5 months after injury.

Fig. 3. Case 1. This roentgenogram, taken 9 months later than the roentgenogram in Figure 2, shows generalized atrophy with increased broadening of the neck and irregularity of the capital epiphysis.

limping, without pain. There is also very little atrophy of the hip muscles. Motion about the hip is normal unless the epiphysis has migrated to the great trochanter; in such a case abduction and rotation are limited. Very little, if any, shortening is found in this type.

The cap type may run a much more severe clinical course. There is a great deal of fragmentation of the epiphyseal bone center. The neck is shorter and more rounded at the upper angle. "In a few cases the epiphysis seems to be obliterated" (Legg). The resulting loss in length and range of motion about the hip is more marked than in the mushroom type.

This disease must be differentiated from tuberculosis, coxa vara, congenital and acquired irregularities of the head of the femur as well as epiphyseal separation fractures. As the disease progresses the clinical course and X-ray findings are diagnostic. Undoubtedly, certain cases of adolescent coxa vara represent the end-result of an unrecognized osteochondritis of the femoral head.

Case 1. An example is that of a white boy of 6 years, well until thrown off a merry-go-round 5 months before admission into the Lakeside Hospital. He did not complain of any pain about the hip immediately following the fall but began to limp a month later. After a period of 2 or 3 weeks, pain developed in the right knee and soon afterward in the right hip. The disability increased until he began to walk on all fours. It is of interest to note that at the age of 6 months he won a prize at a state health contest.

The physical examination revealed a well developed and nourished boy. The right leg showed a shortening of 1 centimeter with atrophy of 2.75 centimeters of the right thigh 17.5 centimeters above the patella. There was no increased surface heat or periarticular thickening at the knee or hip. Motion of the hip was limited about 20 degrees in all other directions. The child walked with a definite protective limp on the right side.

Blood calcium was 13.1 milligrams; phosphorus 5.3 milligrams; blood and urine studies were negative. The roentgenogram (Fig. 2), taken 5 months after the injury (January 17, 1929), showed definite

Fig. 4. Bilateral osteochondritis of the greater trochanter. The patient showed no symptoms referable to the disease.

Fig. 5. Tibial tubercle showing variation in density, as well as irregularity of outline; transverse line through the proximal portion suggested a fracture.

Fig. 6. Early involvement of patella in Case 2. The center of ossification is irregular in outline and decreased in density. Note irregularity of contour of the condyles of the femur.

mottling in the neck of both femora, considerably more on the right. The joint spaces were clear.

On January 24, 1929, shortly after admission to the hospital, the right hip was explored. The capsule, as well as the articular surface of the head, appeared normal, while the neck appeared definitely hyperæmic. Several small specimens were removed just distal to the epiphyseal line. The bone appeared firmer than normal, was hæmorrhagic, and somewhat granular in appearance. All cultures, including those for fungi, were negative. The pathologist reported that no evidence of pathological changes was present in several sections of the cancellous bone.

After 6 weeks, the patient was discharged to a convalescent hospital. At this time his right hip was held by a plaster spica in a position of extension and 30 degrees' abduction. The splint was removed in 6 weeks. Nine months after exploration of the right hip he was free of symptoms and walked without a limp. At this time there was 30 degrees' limitation to abduction and adduction of the right hip but no muscle spasm. Roentgenograms showed the epiphysis of the head of the right femur to be flattened and roughened. There was a slight degree of coxa vara. The head of the left femur showed suggestive early change of the same nature (Fig. 3). The legs were of equal length.

Phemister[1] has reported a similar case; he found a mild synovitis. A window removed from the anterior surface of the head extending into the ossification center showed the latter to be almost broken down in one portion and partly filled with granulation tissue. Cultures were negative. Within 5 months, roentgenograms showed the defect to be entirely filled with new bone.

[1] Phemister. Arch. Surg., 1921.

Practical recovery follows regardless of treatment. If the deformity is rather marked and is progressive, the affected limb should be held in moderate abduction by a short plaster spica. It is rarely necessary to maintain such physiological rest longer than 6 weeks. Occasionally, malacia, as evidenced by roentgenograms, makes further protection advisable; this can be cared for sufficiently by a Thomas ring caliper brace for a few weeks longer.

During recent years several authors have called attention to the potential danger of arthritis occurring in hips previously affected with osteochondritis. A few such patients have been seen by one of us. In the more severe cases, the Whitman reconstruction operation seems to give the best results.

Similar changes may occur in the greater trochanter, as illustrated in Figure 4.

Involvement of the proximal epiphysis of the tibia has been known as Osgood-Schlatter's disease, Schlatter's disease, or tibial tubercle apophysitis. We designate this as a secondary type. Well developed, athletic boys are especially subject to this disturbance about the time of puberty, 12 to 16 years of

Fig. 7. Case 2. A year later than Figure 5. There is increased irregularity of the contour of the condyles, increased growth of the patella but greater degree of mottling.

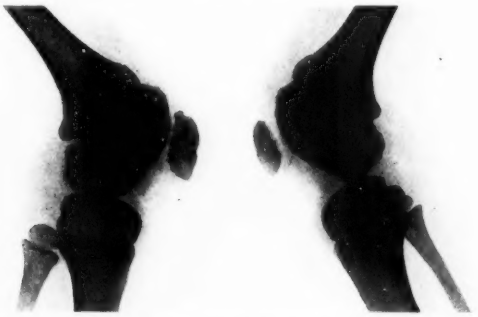

Fig. 8. Case 2. Two years later than Figure 5. This shows the stage of healing. All of the bones show some generalized atrophy.

age. The symptoms usually follow direct trauma or some form of violent exercise where the leg has been smartly extended at the knee. The patient complains of loss of speed in running and aching of the part affected after exercise or climbing stairs. The discomfort may be severe enough to cause limping. Examination may reveal tenderness and thickening of the soft parts about the tubercle. Usually the tubercle becomes definitely enlarged. Active extension of the knee causes pain in the region of the ligamentum patellæ. Roentgenograms show irregularities in shape as well as fragmentation of the tibial epiphysis (Fig. 5).

This common condition is self-limited regardless of treatment. Mild cases may be relieved by cross strapping of adhesive, meeting over the tubercle. In more severe cases, flexion of the knee should be prohibited by a plaster-of-Paris splint over a period of a few weeks; during this period setting of the quadriceps should be practiced, and after removal of the splint, baking, massage, and active motion hasten recovery.

This disease of the patella can be classed usually as a primary type (Figs. 6, 7, 8). However, secondary ossification centers may be found near puberty. The primary type was first described by Koehler in a case having tarsal scaphoid involvement as well. The secondary type has been known as the Sinding-Larsen or the Larsen-Johannson syndrome. The accessory center of ossification is usually at the outer margin of the patella. It may be mistaken for a vertical fracture where it has persisted as a separate center of ossification. Defects in ossification of the patella are not uncommon and when present are bilateral in about two-thirds of the cases. In some cases, roentgenograms have revealed involvement of the patella alone when the symptoms were referable to the tibial tubercle. In others a typical roentgenological picture of osteochondritis of the tibial tubercle has been found with symptoms referable to the patella. This has been explained as due to a local traction tendonitis at the attachment of the patellar ligament to the tibial tubercle and margin of the patella itself.

The same change which occurs in the patella may also take place in the condyles of the femur, the osteochondral line presenting irregularity of outline of the osteoid portion.

Primary osteochondritis of the patella is, therefore, common near the age of 6 years at which time the primary ossification center is rapidly growing. Secondary osteochondritis is frequent about puberty and may be associated with tibial tubercle involvement because both secondary centers are rapidly growing at this age.

Case 2. A white girl, 6 years old, was admitted to the Lakeside Hospital August 20, 1928, because of pain and swelling in the right knee. For 1 year the parents had noticed that she walked with a limp,

Fig. 9. A decrease in volume of tarsal scaphoid, as well as irregularity noted previously.

especially marked in the mornings. In a short time she complained of pain relieved by flexing the knee. She developed swelling about the right knee and night cries. At this time a plaster cylinder was applied to the leg for a period of 6 weeks. Roentgenograms showed early changes in patella and condyles of femur (Fig. 6). The patient seemed well for 3 or 4 months after removal of the plaster splint. At the end of that time she fell, striking her right knee. Within 4 days the knee was more swollen and painful than it had been before.

The physical examination showed a well developed and nourished child. The positive physical findings were confined to the right knee. There was no shortening of the right leg but definite periarticular thickening about the knee with some tenderness over the internal joint space as well as the patella. The leg was held in 10 degrees' flexion, and passive motion beyond this point was painless but slightly guarded. There was increased surface heat.

Blood count showed 8,000 white cells; hæmoglobin 90 per cent; differential count, normal. Wassermann test was negative. Tuberculin test, human and bovine, dilution 1:5000, was positive. The urine was normal. Roentgenograms (Fig. 7) showed definite changes in the patella and articular surfaces of the condyles of the femur.

The knee was explored on September 11, 1928; the articular surface of the patella, as well as the condyles of the femur, had a normal appearance. The synovia was hyperæmic, purplish in color, and hypertrophic. It was thought to be tuberculosis at the time of operation. Cultures and guinea pig inoculation of the 3 cubic centimeters of slightly turbid fluid found were negative. A pathological report of

Fig. 11. The broad flat head of the second metatarsal, as well as the increased density of the shaft, is a characteristic change.

Fig. 10. Lateral view showing fragmentation of tarsal scaphoid.

non-specific synovitis was obtained from fringes of the synovia removed for study.

For 3 months after discharge from the hospital several plaster splints were applied, after which time free use of the part was allowed. She was readmitted to the hospital January 7, 1929, because of persistence of pain and limited motion. The knee lacked 20 degrees of complete extension and 40 degrees of complete flexion. Attempts at further motion were painful and met with obstruction which seemed due to adhesions rather than muscle spasm. A wedging cast was applied and the patient discharged to a convalescent hospital.

On November 30, 1929, extension of the right knee was slightly limited, but no swelling or pain was present. Roentgenograms (Fig. 8), taken November 23, 1929, showed definite improvement.

Treatment of either type of osteochondritis of the patella consists of physiological rest in a plaster cylinder for a few weeks, depending

Fig. 12. Characteristic irregularity, enlargement, and mottling of the calcaneal epiphysis.

Fig. 13. Case 3. Considerable mottling and irregularity of the head of the humerus as well as lipping of the acromion.

upon the severity of the disease. This is to be followed by massage and increase in active motion.

Primary osteochondritis of the scaphoid has been known as tarsal scaphoiditis, or Koehler's disease. It is one of the most common of the primary type. This condition occurs about twice as often in boys as in girls. The scaphoid is one of the last bones of the foot to ossify and develops from a primary center alone. The ossification center appears between the fourth and fifth years. Therefore, this disturbance rarely occurs before that age. The upper limit is about 12 years. Very few of these patients give a direct history of trauma.

The first symptom is a slight limp. Local signs of inflammation are present, such as pain, swelling, and redness. The pain is aggravated by exercise, but the patient may obtain relief by walking on the lateral border of the foot. Roentgenograms show the bone to be decreased one-half to one-fourth the normal size and irregular in shape (Figs. 9 and 10). The bone is increased in density and the normal architecture is lost. The spongy and cortical portions are indistinguishable. Gradually fresh bone develops around the condensed nucleus. In a year or two the bone may acquire natural shape and size.

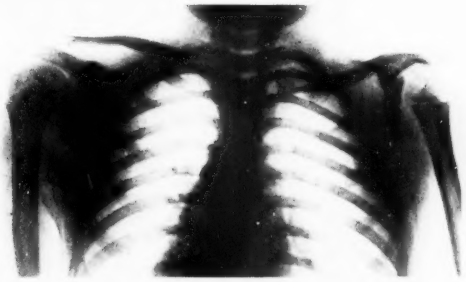

Fig. 14. Case 3. Two years later. Healed stage of the disease in the upper epiphysis of the humerus.

The treatment of the diseased scaphoid is that of physiological rest. When there is considerable pain upon weight-bearing, it is necessary to apply a plaster boot with moderate elevation of the long arch. The splint should be worn about 3 weeks and followed by the application of a soft inner sole, long arch support, and one-quarter inch elevation of the inner side of the heel.

Osteochondritis of the head of the second metatarsal is described as Freiberg's infraction, Koehler's metatarsophalangeal joint, juvenile deforming metatarsophalangeal osteochondritis, second Koehler's disease. This occurs most often in females between the ages of 10 and 15 years. Local pain upon walking referred to the part affected is the chief symptom. Localized tenderness, periarticular

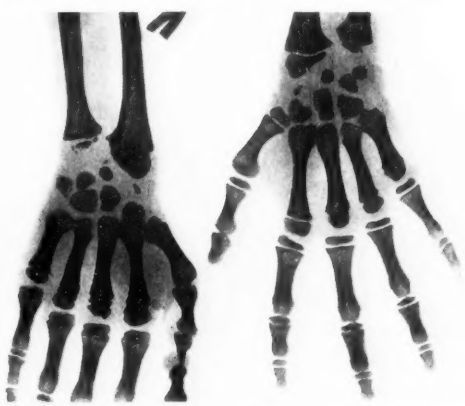

Fig. 15. Primary and secondary osteochondritis showing retardation of development of certain ossification centers, irregularity of the distal ulnar epiphysis, as well as epiphyses of four metacarpals.

Fig. 16. Case 4. Lateral view of dorsal spine showing irregularity of contour of several dorsal vertebræ with mottling and representing a moderately advanced process (a diagnosis of tuberculosis of the spine had been originally made).

thickening, and swelling are present. Plantar flexion of the foot may be limited. The onset often follows a strenuous tennis game in which the ball of the foot must repeatedly stand the impact of the body. Disturbed mechanics of the foot due to high heels has also been suggested as a cause. The first metatarsal escapes because the epiphysis is located at the proximal end. Involvement of the second metatarsal is more common than of the remaining three because it is longer than the rest and bears the brunt of the body forces. Roentgenograms are diagnostic. The head of the second metatarsal is flattened and irregular (Fig. 11). Alterations in the structure of the head, condensation, and rarefaction give the appearance of fracture at times. The cortical portion of the diaphysis usually shows thickening.

Relief is ordinarily afforded by a transverse leather bar three-eighths inch thick upon the shoe just back of the position of the head of the metatarsals of the affected side with a moderately low heel. This serves to remove the weight from the part. In the severe type where loose bodies are present, their surgical removal with partial excision of the head of the metatarsal is required.

Osteochondritis of the os calcis is also known as apophysitis. It is the only example of secondary osteochondritis in the cubical bones, except involvement of the accessory scaphoid in rare cases. This disturbance occurs most frequently in very active boys, from 8 to 14 years of age. These patients complain of pain about the heel upon walking. This is many times severe enough to cause a limp. Examination reveals pain and tenderness over the back of the heel. There may be thickening of the overlying soft tissues. Full dorsi-flexion is limited and any strain on the tendo achillis causes pain. A history of direct trauma is not often obtained.

Roentgenograms may show a widening and cloudiness between the epiphysis and body of the os calcis. The epiphysis is often enlarged and irregular in outline; areas of condensation and rarefaction occur (Fig. 12).

This condition may be confused with a bursitis due to the irritation of a shoe. Tuberculosis generally affects the anterior portion of the os calcis. Other inflammatory diseases of the Achilles tendon can be ruled out by X-ray and the duration of the symptoms.

As in all other types, this condition disappears when the epiphysis joins the diaphysis. However, some relief may be obtained by lifting the heel one-quarter to one-half inch, as well as giving a small inner side lift to the heel if any pronation of the foot is present. A soft felt or rubber pad may be placed under the heel. Local pressure produced by several vertical straps of adhesive passing around the heel may give relief.

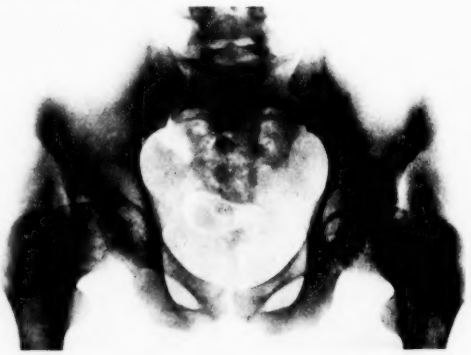

Fig. 17. Case 4. Bilateral coxa vara which was a coincidental finding.

Fig. 18. Case 4. Appearance of the disease at about the healed stage. The contour of several of the bodies remains irregular but the general contour of the spine is normal.

The upper extremities are by no means exempt, for involvement of the head of the humerus has been reported in a case of birth injury (Lewin). Recently we have seen a similar case.

CASE 3. A white boy, 8 years of age, was sent into the Lakeside Hospital November 22, 1929, because of disturbed function in the right arm. Soon after his birth the mother had noted that the right arm was not used as the left. At that time it was thought to be an Erb's palsy. Roentgenograms of the right shoulder in 1927 (Fig. 13) showed definite irregularity of the epiphyseal line with mottling of the epiphysis itself. The patient was 6 years old at that time.

Fig. 19. Case 5. Same patient as in Figure 20. Mild degree of coxa vara and flattening of the left hip.

Fig. 20. Case 5. Dorsal kyphosis with considerable irregularity of outline of the vertebral bodies from sixth to eleventh inclusive.

The physical examination showed a well developed boy. The right arm could be abducted only 35 degrees free of the scapula, with no external rotation, but normal internal rotation. The head seemed to rest high in the glenoid cavity, and upon attempted external rotation there appeared to be a separation of the acromioclavicular joint. Palpation showed definite lipping of the acromion over the head of the humerus. Muscle power and sensation seemed normal throughout the arm. In roentgenograms of the shoulder, taken November 18, 1929, the epiphyseal plate was somewhat irregular but the epiphysis was more nearly normal (Fig. 14).

On November 19, 1929, the distal portion of the acromion was excised and the pectoralis muscle divided. This relieved the limitation of abduction and permitted complete external rotation of the arm. The arm was placed in a plaster spica in 90 degrees' abduction and complete external rotation. The early result showed excellent function.

This condition may appear following injuries of this type, as in the cases which develop in congenital dislocation of the hip following reduction. Panner has reported cases of the secondary type involving the elbow. A direct history of trauma was com-

Fig. 21. Case 6. Dorsal kyphoscoliosis, the result of primary osteochondritis in the arrested stage.

mon in his cases. In Figure 15 both the primary and secondary types are present. The mottled and fragmented epiphysis of the ulna represents the secondary type. The primary type is represented by the mottled appearance of several of the bones of the wrist. Traumatic malacia of the carpal semilunar of Kienboeck, as well as the same type of process in the spine known as Kuemmel's disease, has been purposely omitted because of its occurrence in adult bone.

Vertebral disease has been one of the last to be recognized. At the present time we know that this condition is fairly common. Various authors have called it Scheuermann's disease, juvenile kyphosis, adolescent kyphoscoliosis, kyphosis osteochondropathica, vertebral osteochondritis, vertebral epiphysitis, kyphosis dorsalis adolescentium, and kyphosis dorsalis juvenilis, the latter two suggesting that portion of the spinal column most affected.

Attention to vertebral epiphyses was aroused by A. Koehler in 1915. According to Mau the vertebral bodies have two periods of active growth. The first period involves rapid growth of the primary centers of ossification. This activity is retarded from the age of 6 until the appearance of the secondary centers. The second period of growth extends over a period of 5 or 6 years. In girls the onset of this period is around 10 years and in boys several years later.

Calvé called attention to the fact that osteochondritis of the spine was sometimes found in the very young before the appearance of the epiphyses. This form has been called infantile osteochondritis. This primary osteochondritis may appear within the early years of life and produces a greater degree of deformity than the secondary type. In our series we have one of the primary type which shows a well defined scoliosis (Fig. 21).

The secondary type is the more common. In any case of well defined round shoulders occurring in early adolescence this condition must be considered. Several of our cases of the secondary type were sent by the school authorities to the orthopedic dispensary for examination.

The symptoms and roentgenograms vary according to the degree of advancement of the primary or secondary types. Deformity is often the only complaint of either type. In the primary type the spine may be tender and spastic, simulating Pott's disease. The very young patients may have an awkward gait. Many cases of the primary type have been found by reviewing the roentgenograms of a case with supposedly Pott's disease which made a remarkably early recovery. By the time the symptoms or deformity become severe enough to cause the patient to seek medical aid the roentgenograms are characteristic. There is early mottling and irregularity of contour of the vertebral bodies most affected, which are usually in the low dorsal

Fig. 22. Case 6. The lateral view is not clear but irregularity can be noted in the lower dorsal bodies.

region. The bodies become wedge-shaped and often are almost completely lost. This results in angulation of the spine at this point, depending upon the degree of absorption. In the final stages sclerosis takes place and the mottled appearance decreases. The deformities in untreated patients are usually permanent. These early spinal deformities may be mistaken for Pott's disease or rickets. Some of these patients complain of local discomfort at the site of angulation. Buchman[1], however, concludes that vertebral epiphysitis is not found in deformities of the spine of known origin, such as poliomyelitis, Pott's disease, rickets, torticollis, congenital deviation and inequality of the lower limbs.

Many cases of osteochondritis of the vertebræ of the secondary type (Fig. 26) have been so diagnosed because of roentgenograms taken to discover the cause of round shoulders, or as in the primary by the review of roentgenograms of a self-limiting, typical case of Pott's disease. In several of our cases the patients gave a past history of backache, malaise, and pain in the hips, but their complaint upon entering the dispensary was largely referable to the deformity of the spine.

[1] Buchman. Arch. Surg., 1926

Fig. 23. Case 7. The lateral view shows no definite change in the bodies at this time.

The secondary centers are represented by small triangular bodies at the anterior superior and the anterior inferior margins of the vertebral bodies (Fig. 1). Normally, the outline of the vertebral bodies should be regular and distinct. The intervertebral spaces should be of uniform density throughout. If the intervertebral spaces are cloudy throughout, no significance is attached unless the vertebral bodies are mottled or irregular in contour. In the very early stages, the epiphyses are often enlarged and irregular in outline. The intervertebral spaces are cloudy and seem to blend with the general mottling of the vertebral bodies. The margins of the vertebral bodies are irregular and indistinct. In some cases they appear almost completely destroyed, as in a well advanced case of Pott's disease (Fig. 20). Even at this stage the patient may be without symptoms, although the deformity exists. Gradually from the moth-eaten mass the sclerosed vertebral bodies become better defined. In this stage the bodies show more

Fig. 24. Photograph illustrating spinal posture of Case 5.

clearly their irregular and fragmented borders as well as a wedge-shaped deformity which remains permanent (Fig. 18).

We have included short case reviews of osteochondritis of the spine occurring definitely in three members of the same family; the fourth member, a girl about 12 years of age, has well defined round shoulders but no suggestive symptoms, and the roentgenograms are negative as shown in Figure 23. We believe that she will gradually show changes in her spine as the other members of her family have done. In the two well defined secondary types (Figs. 17 and 19) the hips show coxa vara with flattened capital epiphyses.

No doubt, if complete roentgenograms of the skeletal system were taken on every case of supposedly localized osteochondritis, many additional involved centers might be found.

The first of the following histories represents progress of the disease from an active to an almost healed stage.

CASE 4. A white boy, aged 15 years, entered the Lakeside Hospital dispensary on January 29, 1924, complaining of "spine trouble" and wearing a plaster jacket. The present illness started 2 years previously with an intermittent pain in the lower portion of the spine, and at the onset he was treated in another hospital where a plaster jacket was applied. A tentative diagnosis of Pott's disease was made. On May 17, 1924, the jacket was removed and a brace applied. In July he returned complaining of stiffness in the legs present for the preceding 5 weeks. The Wassermann was negative. Roentgenograms of the dorsal spine showed irregularity in contour of the seventh and eighth dorsal vertebræ quite suggestive of a destructive process involving these bodies (Fig. 16).

Roentgenograms of the hips, taken December 6, 1924, showed a coxa vara of both hips (Fig. 17). The head of the left femur was rather indefinite in outline. The patient was not seen again until July 11, 1929. The physical examination at this time revealed an unusually well developed boy of short stature (Fig. 25). The contour (Fig. 18) and mobility of the spine were relatively normal.

This case represents one of the common examples in which osteochondritis of the secondary type was mistaken for tuberculosis of the spine.

CASE 5. A white girl, 12 years old, of the same family, was first seen January 24, 1925, in the Pediatric Dispensary, complaining of "pain in the left side" of 2 days' duration. Examination revealed a dorsal kyphosis with tenderness over the lower cervical vertebræ. Roentgenograms of the cervical spine showed no definite evidence of pathology. Tuberculin test (1:1000) was negative.

On February 23, 1926, she was sent in by school authorities because of round shoulders and slow growth. The physical examination at this time was negative except for the moderate degree of round shoulders. The trunk of the body seemed short in relation to the extremities. She was not seen again until October 13, 1928, and at this time, the round shoulders and lordosis were exaggerated. She complained of intermittent pain in the left hip, worse when standing. The mother said that the patient limped occasionally. There was no evidence of focal infection. A roentgenogram of the pelvis showed a moderate coxa vara bilateral (Fig. 19).

She returned June 8, 1929 (Fig. 24), with the same type of pain in the hips, as well as in the knees, with no tenderness or muscle spasm about the spine. The kyphosis was moderate. Roentgenograms (Fig. 20) of the dorsolumbar spine showed marked destruction of the anterior portion of the eighth dorsal vertebral body. There were many defects in the lower portions of the bodies of the sixth, ninth, and tenth dorsal vertebral bodies. The patient continued to complain of so much pain in the hip that she was sent into the hospital on the orthopedic service for further study. All laboratory studies were negative, but because of a questionable heart lesion and history of rheumatic fever the patient was transferred to the medical service. A definite diagnosis of rheumatic heart disease was made. During her stay in the hospital she was kept in mild hyperextension by a pillow roll under the midportion of the spine.

This patient demonstrates the onset and active stage of this disease.

CASE 6. A 10 year old boy, of the same family, was sent into the Lakeside Hospital dispensary, February 23, 1926, from school because of his posture and apparent failure to grow normally. The physical examination revealed a fairly well nourished boy but short in stature (Fig. 25). There was a marked lumbar lordosis and sharply rounded dorsal spine with a right dorsal left lumbar scoliosis (Figs. 21 and 22).

When seen on May 25, 1929, his condition was apparently unchanged. He came in by request on July 11, 1929; at this time the kyphoscoliosis had increased slightly.

CASE 7. The youngest member of this family, a girl aged 10 years, was also sent by the school authorities for examination because of poor posture. She had been round shouldered for some time, but free of complaints. The physical examination revealed a well nourished and developed girl apparently in excellent health. The positive findings were limited to moderate degree of round shoulders. There was no tenderness or muscle spasm about the spine. Roentgenograms (Fig. 23) were negative. We believe, however, that this patient will eventually develop changes in the spine similar to those of the secondary type already reviewed.

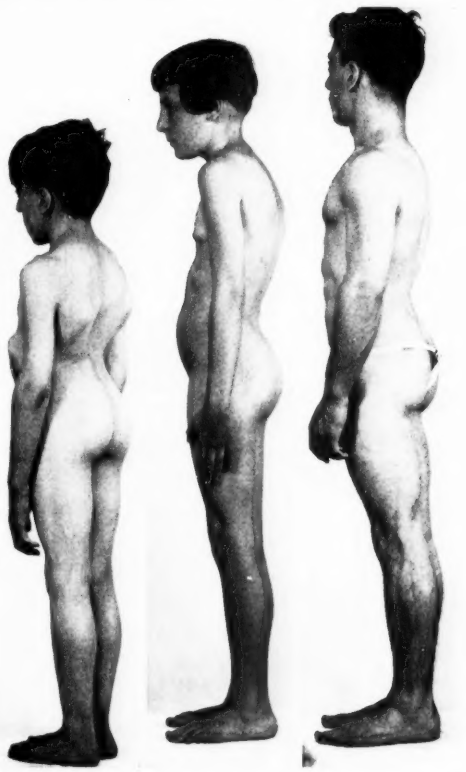

Fig. 25. Photographs illustrating the spinal postures of Cases 4, 6, and 7.

The treatment should be directed toward (1) the prevention of deformity, (2) the correction of deformity if it has already occurred, (3) the relief of pain, and (4) the improvement of general bodily posture.

It can be seen from the cases presented here that pain usually does not play a prominent part toward bringing the patient to the physician. Round shoulders and increased dorsal curve are the most frequent complaints.

During the early period of the disease when pain is complained of, absolute physiological rest is indicated. The child should be placed upon a Bradford frame with angulation of 20 to 35 degrees. The apex of the curve of the spine should rest at the maximum angulation of the frame, thus maintaining the spine in moderate hyperextension. When all muscle spasm has subsided, the patient may be allowed up, either with a plaster jacket or a spring back brace. Sleeping upon the hyperextended frame should be continued until all deformity has been corrected and the brace removed when roentgenograms show a uniform density and outline of the individual vertebræ. Those patients who present no complaint other than deformity require a period of recumbency upon a hyperextended Bradford frame for several hours daily. This should be continued until the maximum correction has been obtained.

Corrective exercises should be directed toward hyperextension of the spine, in such a manner as to restore the normal physiological curves. They should always be started immediately following subsidence of pain in the acute cases; such patients as present only deformity should begin the exercises at once.

When there is a lateral curve combined with an exaggerated anterior posterior curve, the exercises should be of a more specialized character. The general posture of the individual should be considered at all times.

ETIOLOGY

There have been as many etiological factors suggested for this disease as there have been

Fig. 26. Moderately advanced osteochondritis of the secondary type occurring in a girl 14 years of age.

names. To our knowledge the etiology has never been clinically or experimentally proved. It cannot be denied, however, that trauma either in a direct or indirect form plays a major part in many instances regardless of location. A definite history of trauma was obtained in Case 1. It cannot be denied as a factor in those cases which develop following birth injuries and congenital dislocation of the hip. A traumatic factor is often present in cases involving the elbow, tibial tubercle, and second metatarsal.

Indirect violence due to increased stress and strain resulting from muscle or tendon traction is another important factor. The disease is most common at the points of increased stress, for example, the head of the femur, heel, and scaphoid. The scaphoid, the last of the ankle bones to ossify, is subject to increased stress. The tibial tubercle and calcaneus because of attachment of a large ligament also fall into this group. The vertebræ are involved in the low dorsal region where the vertebral bodies are subjected to increased indirect trauma. This is true in both the primary and secondary involvement of the spine.

In many cases a history of direct trauma is not obtainable; therefore, another factor must be considered to explain the selective factor in certain cases. Why should the spine be affected in four members of the same family? Hanson considers heredity as a possible etiological factor in vertebral disease. He bases his conclusions on 6 cases showing involvement in a child, parent, and grandparents. Perhaps a tendency toward malacia of ossification centers during periods of active growth may be of hereditary origin.

Leriche and Policard in their book on *The Physiology of Bone* offer an explanation on the basis of vasomotor changes. The fact that increased circulation results in bone rarefaction is well established.

There frequently exists osteoporosis, more or less localized or diffuse, which is developed after peripheral nerve traumata. These instances are observed especially in the small bones of the hand and of the foot, after an accident which has apparently not been serious. In a few weeks an "atrophy" of the bone, a decalcification, is visible on radiography. It is accompanied by pain and functional impotence, which at times are wrongly called traumatic arthritis. . . .

The affected bones are rarefied. We know that there is no rarefaction without hyperæmia and that hyperæmia can be accompanied by it. Now, on the other hand, all peripheral nerve traumatism is accompanied by a more or less lasting disturbance in equilibrium which begins with vasoconstriction and quickly turns into a vasodilation, which the oscillometer clearly shows. . . .

This is what we have called reflexes of the traumatized axone. Albert has shown that experimentation brings about this state in conditions which permit of no other interpretation. . . .

Here it may be properly asked whether a parallel mechanism is not the origin of certain singular syndromes which have been elevated to the dignity of specific bone diseases, such as the *tarsal scaphoiditis* of Koehler, the *traumatic malacia of the semilunar* of Kienboeck, the *osteochondritis deformans of the hip*, Calvé-Waldenström-Legg-Perthes disease, and the vertebral deformities of Kuemmel-Verneuil disease.

It is very probable that still other isolated localizations of this bone rarefaction of traumatic vasomotor origin will be found, and that other specific diseases will yet be diseases of X—— or of Y——. One can say that from now on all will have the same character, an insignificant trauma or one

distant in origin, an evolution which is slow, progressive, apyretic, accompanied by slight pains and resulting in final spontaneous curability, with at times definite bone deformity and absence of all signs of inflammation. Up to the present, pathology has not taken account of the reflexes of the traumatized axone. Now that the intimate relation which unites vasodilation and bone resorption is known, it is permissible to believe that the syndrome which they bring about should be frequent.

It would be difficult, however, to explain on this basis the bone sclerosis in the neck of the femur and diaphysis of the second metatarsal which accompanied the rarefaction of the epiphyses. Perhaps a combination of these factors plus some underlying cause with which we are not as yet acquainted may be responsible for the disease.

SUMMARY

The literature on osteochondritis includes almost seven hundred articles. Up to the present time no attempt has been made to simplify the multiplicity of terms used to describe the same type of pathology which occurs in various ossification centers of the body. We have attempted to bring together a review of the literature upon this disease in an effort to simplify and standardize the terminology. This study was prompted by four cases of vertebral involvement occurring in the same family.

The anatomy and age incidence of the centers of ossification have been discussed in order to explain our classification as well as to define the age limits. This combined with a historical review has been illustrated in Figure 1.

Osteochondritis involves either the primary or secondary center of ossification during their periods of active growth. The disease is self-limited by complete ossification.

To include all types of osteochondritis we would classify them either into the primary or secondary type depending upon whether the primary center of ossification or secondary center is first involved. This classification immediately places involvement of all the cubical bones of the wrist and the feet, except the calcaneus, into the primary group. These bones do not have secondary centers of ossification, except the calcaneus and occasionally the accessory scaphoid. In the spine both the primary and secondary types have been described. The epiphyses in the spine develop rather late and have two periods of active growth; the first involves the primary center during the first decade and the second the secondary center during the second decade. A primary type may continue until the appearance of the secondary centers, or both types appear simultaneously in the same patient.

The more common locations are discussed, including terminology, symptoms, roentgenological findings, prognosis, and treatment. Case reviews of hip, patella, humerus, and 4 cases of spine involvement in members of the same family are given. Both primary and secondary types of osteochondritis are represented in the cases of spine involvement, the secondary cases representing the disease in the initial, active, and arrested stage.

The etiology of the disease is unknown. However, direct trauma, or indirect trauma as a result of increased stress and strain from the body forces, appears to play an important rôle. Heredity may be considered as a possible etiological factor as considered by Hanson and represented by our series of four members in one family having involvement of the spine. Leriche and Policard offer an explanation from vasomotor changes based on the reflexes of the traumatized axone. Perhaps a combination of the factors added to some unknown cause may be found to be responsible for this disease.

The treatment varies according to the location of the disease. In general, a period of physiological rest of 4 to 6 weeks is essential. When plaster supports are dispensed with some mechanical device may be used to prevent recurrence of the deformity until the period of active growth of the center involved is over. It is thought chronic arthritis may develop in the involved areas in later years.

NOTE.—A complete bibliography of some seven hundred references will be printed in the reprints of this article.

A CYSTIC DERMOID TUMOR OF THE SPINAL CORD

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TERATOMA cysts of the dermoid type arising in relation to the spinal cord are relatively uncommon. A search of the literature has revealed the records of 13 cases extending over a period from 1883 to 1928. The comparative rarity of the condition, therefore, as indicated by its bibliography, the interest which attaches to the unusual sequence of the clinical history, and the distinctive feature of its morbid anatomy are the reasons which would seem to justify the publication of the present record.

G. D., aged 22 years, miner, single, was admitted to the hospital December 4, 1928.

History. In December, 1927, the patient suffered from a severe attack of influenza. There was some post-influenzal disability, but by March, 1928, a condition of reasonably good health had been regained. Early in July, 1928, a sensation of discomfort was complained of over an area in the small of the back, which, according to the patient's description, could be covered with the palm of the hand. Though most marked in the midline, the discomfort occasionally passed in a girdle-like manner around the waist and extended into both groins. When asked to describe the sensation of discomfort, the patient replied that it was a curious numblike feeling, with occasional shooting pains. It was apparent that the symptom was aggravated by weight-bearing and movement, for there was exacerbation at the end of a day's work or after a long walk. Correspondingly, rest, particularly in a prone position, gave some measure of relief.

At the end of August the discomfort altered in character, becoming definitely painful and persistent. Its area of distribution extended so that the pain radiated into the buttocks and along the posterior aspects of both legs as far as the ankles. There was also a distribution of pain in a girdle-like arrangement round the abdomen and extending from xiphisternum to umbilicus.

The condition was at this time regarded as a lumbago, and investigation by a careful medical observer revealed two points either or both of which was suspected of being related to the vertebral and abdominal pain. These were a moderate amount of bilateral pes cavus and an unusually pendulous scrotum with bilateral varicocele. It was believed that the former error was responsible for a derangement in the mechanics of the dorsolumbar region and that the drag of the pendulous scrotum might explain in some measure the abdominal and groin pains.

In the latter half of September a new feature made its appearance; the patient noticed that just as sleep was approaching there would occasionally be a series of generalized and clonic contractions of the muscles of both lower limbs. It was a disconcerting development, which delayed his sleep and which might be repeated several times in the night.

During the last week of October the first evidence of interference with the gait appeared. The patient noticed that after walking for a few minutes he experienced a sensation as though he had lost control over one or other of his lower limbs. The derangement was first noticed in the left leg, but later it appeared on the right side, and occasionally both legs showed the error simultaneously, so that, if he could not clutch at some adjacent support, he fell to the ground. About this time the patient first became conscious of tingling sensations and feelings of "pins and needles" in the limbs, more especially on the anterior aspects of both thighs.

During November the weakness of the lower limbs, the paræsthesia, and the occasional muscular spasm continued, the pain, both local and radiating, became more acute, and the low thoracic region of the spinal column acquired a rigidity in an attitude of mild kyphosis, which interfered still further with the gait. The pain, the interference with sleep, and the increasing sense of mental depression affected the general well-being, but the appetite remained good and there was no loss of weight. As early as the middle of October the patient had noticed what at first appeared to be an increasing frequency of micturition, and by mid November it was evident that there was some interference with bladder control; the patient had difficulty in retaining his urine, and it occasionally passed without his knowledge. Constipation had been a lifelong feature, but it was noticed that with the derangement in the urinary function there was an increasing tendency to urgent defæcation.

The patient's father is 55 years old. Eight years ago he had a cerebral hæmorrhage and is now a hemiplegic. The mother, a woman of 49 years, suffers from diabetes. The family numbered 11, and one child died in babyhood of meningitis.

General examination. The patient was a young man in good general condition. His intelligence appeared to be below the average; questions were answered in a slow, hesitating manner, and it was difficult to elicit reliable information in such details of examination as the investigation of tactile sensibility. The gait showed an evident rigidity of the lower spine, while the movements of the lower limbs gave an impression of spasticity, particularly on the left side. While in bed the patient preferred to lie supine with the hip and knee joints flexed.

Nervous system. Cranial nerve function was normal. There was wasting of the muscles of both lower limbs, and this feature was particularly noticeable in the extensor muscles of the left thigh. All voluntary movements could be carried out, but they were slow and unduly deliberate, and they were arrested by a moderate amount of resistance. The co-ordinative functions of the muscles of both lower limbs were interfered with. There was flaccidity and evident weakness in the subumbilical portion of the rectus abdominis and in the lower portion of the oblique and transversalis muscles. No response could be obtained to stimulation of the cremaster muscle and the unduly pendulous condition of the scrotum has already been referred to. The musculature of the back, the upper limbs, and the head and neck showed no error.

Perhaps the most remarkable feature in this stage of the investigation was the variability in the results of the sensory function as shown from one day to another. There was a constant loss of tactile sensibility on the outer aspects of both thighs and over the abdominal area from the subcostal line downward. In the other areas the recognition of tactile sensibility was normal (Fig. 1). The distinction of superficial pain was abolished over the outer aspect of the left thigh. The induction of pressure pain resulted in an exaggerated appreciation in all parts of the lower limbs. In three areas of the lower limbs there was inability to distinguish between sensations of heat and cold. These areas were the outer aspect of the left thigh, the anterior surface of the right leg from the knee to the ankle, and an area on the anterior surface of the scrotum on the left side (Fig. 2).

Investigation of the compass test (Weber's) showed that this appreciation was lost over the skin surfaces of both lower limbs below the knee (Fig. 3). There was evidence that the sense of position in both lower limbs was deficient, but it was difficult to secure the co-operation of the patient in investigating the point.

A girdle area of numbness and tingling extended from the subcostal line upward for a distance of about 2 inches. There were areas of tingling on the inner aspect of the left thigh and over the dorsal surfaces of both feet. A constant area of paræsthesia existed above the left groin.

An extensor response (plantar reflex) was elicited in both feet. The cremasteric reflexes were absent on both sides; the abdominal reflexes were also absent from a level immediately above the umbilicus downward. Oppenheim's sign was present in both lower limbs. There was exaggeration of the knee and ankle jerks on both sides, those of the left side being more active as contrasted with the right. An adduction response was elicited on the left side. Ankle clonus could be elicited on both sides, but more readily on the left. There was some degree of retention of urine. It was passed at frequent intervals, but the patient might be unconscious of its passage. The average amount passed at one time

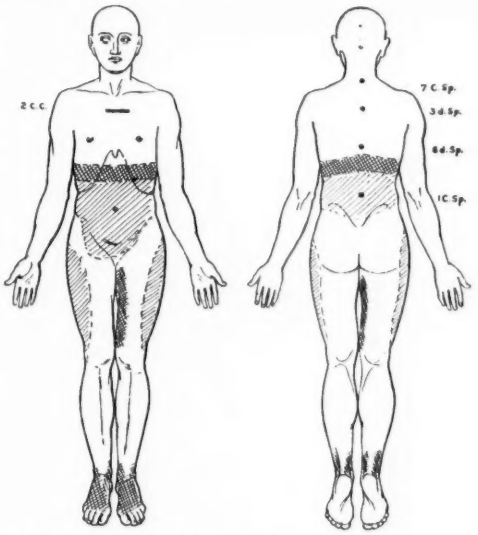

Fig. 1. The crossed diagonal lines indicate the areas of hyperæsthesia and the diagonal lines indicate the areas of anæsthesia.

was 4 ounces. Under ordinary conditions there was troublesome constipation, but when the stools were liquid, as was the case after a purgative, there was a precipitate action of the bowel. Rectal examination revealed a loss of the sphincteric tone.

The circulatory, respiratory, urinary, and alimentary systems revealed no abnormal features.

Wassermann reaction of cerebrospinal fluid was negative. Lumbar puncture at the level of the third lumbar interspace revealed a limpid fluid, slightly straw-colored; there was no apparent increase of pressure. Examination of cerebrospinal fluid showed a cell count of 1 per cubic centimeter (small mononuclear), globular content slight increase, colloidal gold reaction 0012200000.

X-ray examination. An ordinary examination of the vertebral column revealed a moderate degree of lordosis in the thoracolumbar spine with a wedge appearance of the fifth lumbar vertebra.

On December 7, 10 cubic centimeters of warm lipiodol was injected into the subdural space at the level of the third lumbar interspace. The patient was then placed in an inverted position, and after 15 minutes the vertebral column was X-rayed in anteroposterior and lateral position. It was found that the upward passage of the lipiodol had been arrested at the level of the body of the eighth thoracic vertebra (Fig. 4).

Cistern puncture and Queckenstedt's test. Cistern puncture revealed cerebrospinal fluid under normal pressure. Specific gravity 1.006, cell count 1 per cubic centimeter (type not stated), globulin not increased. By means of Ayer's method an attempt

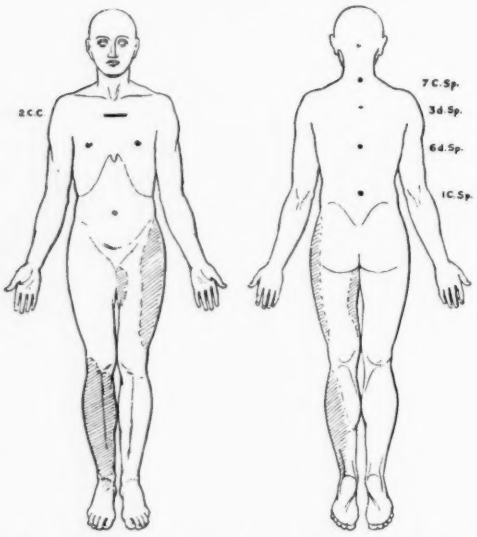

Fig. 2. Shaded areas indicate loss of thermal sensibility.

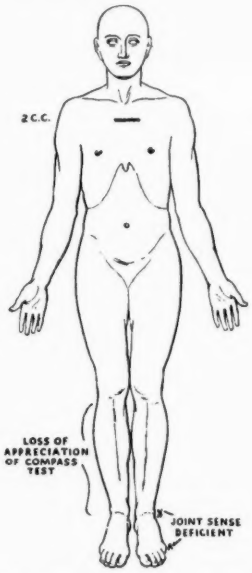

Fig. 3. Estimation of joint sense and compass test.

was made to demonstrate whether or not a spinal block existed, but the result was unsatisfactory.

Provisional diagnosis. All the data of the past history and the objective examination indicated a pressure influence upon the spinal cord; only by this explanation could one account for the sequence of events in the clinical history, the spasticity and increasing weakness of the musculature of the lower limbs, the disturbance of sensation in the same areas, and the serious derangement of the organic reflexes. The site of the disturbance appeared to be at the level of the seventh or eighth thoracic segment, this being indicated by the distribution of the sensory disturbance and confirmed by the evidence of the lipiodol injection.

The transverse localization of the lesion was next considered. The X-ray examination of the vertebral column excluded an osseous source; a pressure influence originating in the extradural space was apparently negatived by the distribution of the motor and sensory disturbances; a meningeal source was considered in such various forms as hypertrophic pachymeningitis, the circumscribed serocystic leptomeningitis (Krause and Horsley), chronic syphilitic meningitis, and the group of meningeal neoplasms. It was thought that these possibilities might be excluded in the absence of previous infective influences and the closely coincident onset of motor and sensory disturbances. An extramedullary meningeal tumor was debated, and, in view of the partial one-sidedness of the physical signs (left side) and the evidence of root pressure, this was the provisional diagnosis, though, in view of later findings, it was evident that it was difficult to associate a meningeal neoplasm with the alteration in superficial and deep sensations and the apparent coincidence of motor and sensory disturbances. However, the provisional diagnosis was made of an extramedullary meningeal tumor, either posterior or posterolateral in position.

Operation. December 11, 1928. Prone position and intratracheal anæsthesia. The sixth thoracic space was indicated by a skin scratch, and, recognizing that level as the center of the area to be brought under review, the spinous process was exposed by a longitudinal incision slightly convex to the left. The mass of the erector spinæ muscle (spinalis dorsi) was separated from the lateral surfaces of the spinous processes and from the posterior surfaces of the laminæ. Hæmorrhage was controlled by gauze packs and, when bleeding was arrested, the muscular masses were held apart by self-retaining retractors. After division of the supraspinous and intraspinous ligaments, the spinous processes of the fifth, sixth, seventh, and eighth thoracic vertebræ were removed. The ligamentum flavum between the laminæ of the seventh and eighth vertebræ was divided, and by means of the access thus gained the spinolaminar segments of the fifth, sixth, and seventh vertebræ were removed. This gave access to the extradural fat with its venous plexus; careful gauze dissection removed the layer and laid bare the glistening dural surface. Particular care was taken at this stage to arrest all hæmorrhage, and the area was bathed in a warm solution of 2 per cent novocain. Loop sutures were inserted into the dura

on either side, and the membrane was opened in the midline. Mesial division of the arachnoid membrane followed, and the posterior aspect of the spinal cord covered with pia mater was exposed. No tumor was apparent in the area under review, and further orientation was therefore necessary. This was achieved by the insertion of a lumbar puncture needle into the subdural space at the level of the first lumbar interspace and the injection of 5 cubic centimeters of sterilized methylene blue solution. As the injection did not appear in the operation field, it was assumed that the compressive influence existed below the operation level, and the spinolaminar segment of the eighth thoracic vertebra was therefore removed, the mesial dural and arachnoid incisions were prolonged downward and a further segment of the spinal cord exposed. A tumor was now apparent. Its surface was silver-gray and glistening in appearance, it resembled a date stone in outline, its length measured 4.5 centimeters, its maximum diameter was 0.7 centimeter. It appeared to be invested by the pia mater, and its central long axis corresponded accurately to the posterior median fissure of the cord. The appearances were those of a dermoid or epidermoid cyst, and, after careful division of the investing pial layer, the cyst was easily enucleated. The cavity which remained was actually an exaggerated posterior median fissure, tapering into the normal outline at the higher and the lower levels, the appearance at the center of the long axis of the cavity suggesting an incomplete duplication of the cord. The center of the cyst corresponded to the upper level of the ninth thoracic segment (Fig. 5).

The cyst proved to be of the epidermoid type, that is to say, its walls were formed of a basement membrane lined with several layers of epithelium, no glands or hair follicles being represented. The contents were pultaceous and composed of fat, cholesterin, and round glistening friable bodies formed by the concentric deposition of epidermoid flakes and degenerate cells, characteristics which gave the contents an appearance resembling that of the cholesteatoma.

Fig. 4. Roentgenogram of spinal column showing arrest of lipiodol at the level of the eighth thoracic segment.

THE CYST ORIGIN

If, following the description of Salotti (2), we subdivide teratomatous cysts into dermoid and epidermoid types according to the structural characters of the cyst wall, the condition under discussion was an example of the epidermoid variety.

When we recall the developmental processes by which the spinal cord arises, it is evident that an epidermoid cyst of the spinal cord will rank in Bland Sutton's classification as a sequestration type. The infolding of the ectodermic neural groove to form the neural tube is the natural procedure, and it is evident that any further inclusion of ectodermic tissue may be the process by which a sequestration cyst may arise.

Torok (3) attaches importance to the date at which the pathological ectodermal inclusion occurs. He believes that a very early inclusion means the isolation of ectoderm, the cells of which are completely potential and are therefore capable of the formation of hair and glandular appendages. Inclusion of a later date involving cells the function of which is already determined—unipotential, simple cutaneous cells—means that the walls of the epidermoid cyst are composed of one or more layers of flattened epithelium. Arguing from this basis, Bostroem (1) believes that the epidermoid cyst has its origin in an inclusion error which dates from some time between the fifth and sixth week of intra-uterine life. This must of necessity, however, remain a

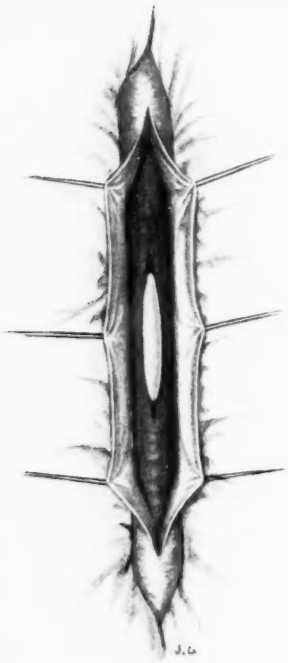

Fig. 5. The cystic dermoid tumor of the spinal cord as it appeared at operation.

polemic question, and one with no real practical significance. It is evident that the cyst under discussion has arisen by reason of an inclusion of ectodermal tissue superadded to that which normally occurs in the course of the formation of the spinal cord, and probably the exact origin may be pictured somewhat as follows. On division of the ectoderm into horny layers and medullary plate, cells of the horny layer have remained in the substance of the medullary plate, and have there developed into a sequestration cyst.

THE PATHOLOGY OF THE CYST

The cyst occupied a position which might be described as subpial and extramedullary. It lay in immediate contact with the spinal cord, its presence produced a considerable cavity formation in the outline of the cord, yet it lay on the surface and no division of nerve tissue was necessary either to expose or to remove it.

A study of the literature recalls how varied are the situations and depths of cysts of this type—extradural, intradural, pial, intramedullary, and intra-ependymal—and these very variations in depth would seem to support the hypothesis that there is a distinction in the time incidence at which these cysts originate. Verebelley's (4) case is sometimes quoted as a demonstration of this point. A boy of 15 years showed two cysts, extradural in position, one typically dermoid in structure, the other lined with embryonal neuro-epithelium, a canal unlined by epithelium connecting the two cavities.

In the present instance the level of the cyst was at the upper limit of the ninth thoracic segment, and this is in keeping with the records of previously recorded cases. The thoracolumbar area is the position of election. In 13 cases recorded in the literature the cyst distribution was as follows: 6 lumbar, 4 thoracic, 2 cauda equinal, 1 diffuse and multiple.

It is significant that it is in this area that the majority of spina bifida errors appear, and it is interesting to surmise what the influences are which predispose this segment of the body to such congenital errors.

CYST WALL AND CONTENTS

The silver-gray appearance of the cyst wall was an impressive feature; it was produced by an unpigmented epithelium, thin enough to permit appreciation of the color of the pultaceous contents. Microscopical examination of the wall showed that it was composed of elongated epithelial cells, three to five layers being the average thickness. Those cells which lay next the cavity were crudely ependymal in outline, they were obviously proliferating, and their desquamation produced the contents with which the cyst lumen was filled. The cyst wall was relatively avascular; a few vessels lay in the subepithelial space. The nature of the contents has already been described (Fig. 7).

THE CLINICAL FEATURES

Viewed from a pathological basis, it might be anticipated that pressure effects on the columns of Goll and Burdach gave rise to

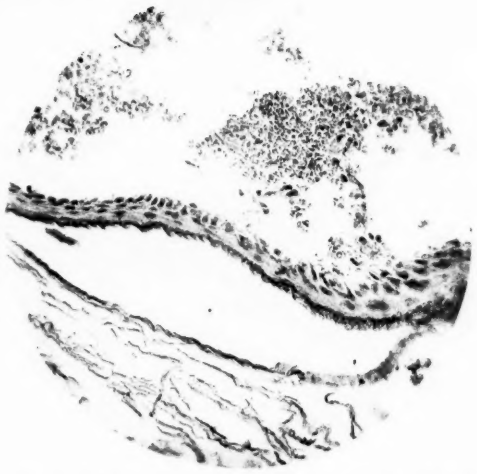

Fig. 6. Section of cyst wall showing laminated epithelial lining. (× 240.)

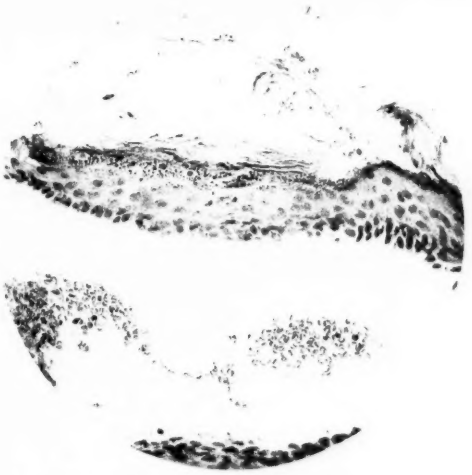

Fig. 7. Photomicrograph of cyst wall showing a tendency to ependymal formation in certain cells. (× 240.)

the original and outstanding clinical signs. It will be recalled that these tracts are ascending in character, and are concerned with the transmission of the following types of sensation: (1) the tactile sensation which recognizes two separate points of contact; (2) tension impulses arising from muscles and tendons; (3) position sense as transmitted from articulations; (4) impulses indicating the sensation of vibration.

It is of interest to recall for a moment in tabular form the epochs of the case history, and they may be summarized as follows:

December, 1927....	Influenzal illness.
July, 1928.....	Pain in lower thoracic spine. Early girdle sensation.
August, 1928.....	Pain in posterior aspects of both lower limbs.
September, 1928....	Clonic spasm in both lower limbs chiefly evident at night.
October, 1928.....	Ataxic gait, loss of sense of position in lower limbs, particularly on left side, paræsthesia on lateral aspects of both thighs.
November, 1928....	Disturbance of organic reflexes. Rigidity in spinal column.

It is apparent that until July, 1928, that is to say during 21 years of life, the cystic tumor had been existent and tolerated. Its influence as a deforming factor on the posterior column of the spinal cord was probably a matter of accommodation in respect of the nerve tissue, and, so long as this could be arranged, no symptoms arose. It is interesting therefore to surmise what was the factor which instituted the increased pressure and so led to the progressive development of symptoms. It was suggested that the influenzal infection might be responsible in so far as it induced a congestive change in the cyst wall and thus increased its relative bulk, but the comparative avascularity of the cyst, and the length of time which elapsed between the infection and the first signs of nerve pressure, would seem to exclude this explanation. It is more likely that the symptoms arose when disparity appeared between the ratio of growth of the cyst and the body tissues. Hitherto both had been growing at a relatively equal proportional rate; after the age of 21 years the growth of the spinal column ceased, the vertebral canal reached its maximum caliber, but the cyst continued to enlarge, and it was but a matter of a few months before the disproportion factor asserted itself and pressure on the posterior columns of the cord began to be exerted.

The stage of pain in the back was evidently synchronous with the first pressure effects. A root cycle then developed; it was bilateral in character and due to irritation of the posterior nerve roots as they lay between the enlarging tumor and the relatively fixed points of the ligamenta denticulata. It was significant that, in contrast to tumors arising from the meninges of the cord, pain was relieved when the patient was recumbent and was exaggerated by the erect attitude, while it was accentuated by weight-bearing and by movement.

The further clinical history was that of a gradually increasing spinal pressure from a focus occupying a posteromedian position. Severe convulsive contractions, mainly evident at night, probably owed their origin to stimuli of the anterior root fibers, and the nocturnal incidence of the feature suggests that a congestive stimulus, activated in some measure by the dorsal position, may have been at work.

Three months after the onset of symptoms the most evident features were those originating from pressure on the posterior tracts of the cord—inco-ordination in the purposive movements of both lower limbs, an ataxic gait, a loss of appreciation of the sense of position and of the compass test. The absence of the Brown-Sequard syndrome should have proved an important indication in the orientation of the tumor. The syndrome appears when the conductivity of one-half of the spinal cord is largely interrupted; in the case under review it is evident that the position of the cyst was so exactly central that, as expansion occurred, the pressure was distributed in a relatively equal fashion on both halves of the cord.

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VARICOSE VEINS AND THEIR TREATMENT BY THE INJECTION METHOD

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THE time has come when the thoughtful clinician need wait no longer for further evidence to allow him to decide on fact as to the best method of treating varicose veins of the lower extremities. In the last 2 years the literature, notably from France, England, and this country, has grown voluminously and detailed in its description of the injection method of treatment and in the statistical comparison of its results with the operative method. In every instance experience has yielded uniform results regarding its safety, its advantages over the operative treatment, and its contra-indications. As well, experience has brought forth warnings against the misuse to which this treatment is naturally susceptible because it is a relatively easy treatment which can be administered in one's office. Aside from technique, unless the physician understands the circulation of the limb and the pathological physiology in any given condition, disrepute will be brought to any form of treatment no matter how excellent it may be if properly applied. While the clinician is hesitating to advise radical excision of the varices and at the same time is hesitating to advise the injection method because of the paramount question of safety and end-results, a veritable army of early as well as late sufferers from this condition is allowed to grow continuously worse regardless of the palliative measures employed. This paper is presented to bring these newer facts before you that may help you to decide in behalf of the best interests of such patients and to review the results obtained in a series of cases treated in the Dispensary of Washington University.

HISTORY

The obliteration and cure of varicose veins by the injection of sclerosing solutions into their lumen is not the recent discovery that its rather sudden and popular use would lead one to believe it to be. Although it is within so brief a time as the last 2 or 3 years that this method has been brought into such practical use as completely to supplant the operative treatment wherever it has been tried, yet as long ago as 1845, soon after the method of syringe injection was introduced by Rynd and popularized by Pravaz, the treatment of varicose dilatations by obliterating injections was attempted. These attempts by Chassaignac and Pravaz by means of ferric chloride; by Valette, by means of the iodotannic liquor; and of Schiasse, by means of red mercuric iodide, are a matter of record. Each of these solutions proved to be extremely irritating and caustic. Also at this time the doors to the true science of bacteriology and pathology were just being opened by the epochal work of Pasteur and Virchow and asepsis was still unknown. In consequence, the method failed and was abandoned due to the resultant sloughs and infections with their associated hazardous complications, such as thrombophlebitis, gangrene, embolism, and septicæmia.

Antedating even this, for as long perhaps as mankind has existed, nature has attempted by the same means to rid the sufferer of his varices by the method of septic thrombophlebitis, which differed in no appreciable way from the manner in which the injection method was first applied except in that the former was accidental and the latter induced. It is not uncommon still to treat many patients in the dispensary for bacterial thrombophlebitis, the result of varices neglected by years, followed by hæmatogenous infection of the traumatized vein or an infection from without through a break in the skin. The exciting agent, in this instance bacterial, is not primarily sclerosing in character, but rather suppurating, liquefying, and propagating in its action on the vein wall and the loosely separated clot within. Under the most ideal circumstances and with

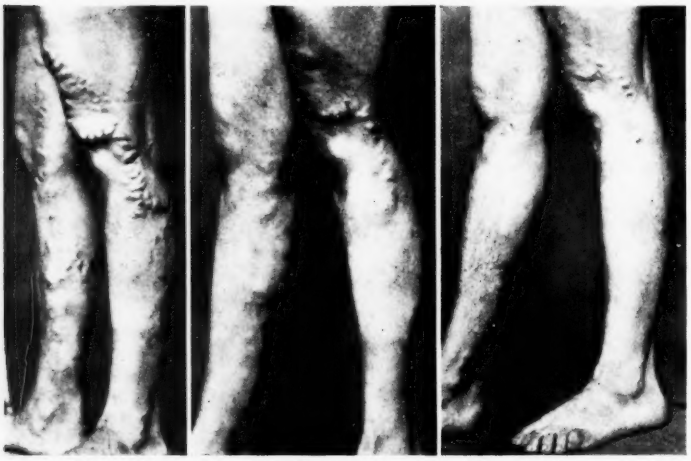

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Advanced generalized involvement of the great saphenous system of both legs in female aged 36 years. Communicating veins are entirely competent. No secondary tissue changes.

Fig. 2. Same patient as in Figure 1, 5 weeks later after 3 weeks' treatment with five injections of sodium salicylate, three of which were given in left leg and two in right. Note partial disappearance of veins.

Fig. 3. Same patient as in Figure 1, 5 months after first picture. Received no further treatment other than that given before Figure 2 was taken. Note the complete atrophy of the veins with puckering of the stretched inelastic skin that once covered the varices.

the most intelligent care this condition is most hazardous to life and permanently invalidating for the remainder of life if the deep veins become involved. If, however, after a long and tedious convalescence, the patient recovers, the final result, too, is permanent obliteration of the diseased veins by organization and fibrosis, and the patient may be improved ever after provided the involvement was not too extensive. So we have illustrated here in the very complication of varicose veins which we hope to avoid, an age old suggestion by nature of the treatment that we now have thoroughly in our control and can apply with precision and safety.

The method remained forgotten until 1911 when it was noted that certain solutions used intravenously in the treatment of disease caused obliteration of the veins without inflammation, pain, or embolism. Blum made the observation with sodium bicarbonate in the treatment of diabetic coma, and P. Linser with mercuric chloride in the treatment of syphilis. Sodium bicarbonate required several injections and was indefinite in its results. Mercuric chloride was used reservedly by Linser for the obliteration of varices until 1922 when its guarded use was abandoned by him in favor of sodium chloride, due to the toxic properties of mercury.

Between 1911 and 1921, however, this method enjoyed its true renaissance, as it remained for Sicard to rediscover the rationale of this treatment during the war when he noticed that certain alkaline solutions injected into the veins of the elbow brought about their obliteration painlessly. Researches were then carried out by Sicard, Paref, and Forestier with the idea of applying this property of alkaline solutions to the treatment of varices. As a result, in 1920, sodium carbonate 20 to 40 per cent in small amounts was recommended. This proved to be too caustic and in spite of its excellent sclerosing properties is now only of historical interest; the slightest drop outside of the vein causing necrosis of the skin. In 1921, Sicard began the use of sodium salicylate, which he found much less caustic and

equally efficient in its results. By 1924 Sicard's results showed thousands of injections with sodium salicylate without an embolus. The method, which is now popularized in France, was not slow to spread into the clinics of England, Sweden, Austria, and of this country as well.

The next paper that justly received almost universal consideration because of the large experience it embraced was that of Forestier in 1928 in which more than five thousand injections without a fatality or embolus are reported, various solutions being used which meet the requirements satisfactorily. It is out of the work of this French clinic that the present injection method of treatment has received such sudden enthusiastic and universal acclaim in these few years that have followed.

There followed reports from representative clinics so favorable and, in each instance, so superior to the operative treatment that the use of this method was begun in the Washington University Dispensary in July, 1928. During the first 15 months, 104 consecutive cases were completely treated. No surgical operation for varicose veins has been performed at Barnes Hospital since the injection treatment was initiated.

ETIOLOGY

In speaking of varicose veins through this presentation, it should be construed as meaning only varices of the lower extremity which constitute the clinical entity with which this paper is interested. It is the great saphenous system with the longest superficial vein in the human body, that is most frequently involved. The smaller saphenous system may present the greater involvement occasionally but most often takes a lesser part in the complete picture.

Of the 104 cases completely treated, 27 (26 per cent) were males and 77 (74 per cent) were females. Their ages ranged from 21 to 74 years averaging 46 years for the series. Varices occurred in both limbs of 54 (52 per cent); in the right limb only in 26 (25 per cent); and in the left limb only in 24 (23 per cent) of the cases. Thus a total of 158 limbs were treated.

Fig. 4, left. Localized advanced varices associated with incompetency of communicating veins. Note advanced secondary tissue changes with small ulceration.

Fig. 5. Same patient as in Figure 4, 3 months later after treatment with two injections of sodium salicylate. Varices are atrophied and ulceration is healed.

In 72 (69 per cent) the condition was advanced and generalized in one or both limbs. The duration of the varices varied from 1 to 40 years with an average duration of 12.7 years. Ulcer was present in 51 (49 per cent) of the cases with a duration of 1 to 20 years and an average duration of 3 years.

There is a greater frequency among females and a tendency to involve both limbs, though neither limb appears predisposed when only one is involved. The striking thing is that the long average duration of both varices and ulcers illustrates how poorly we have had this condition in our control in the recent past. It will also serve to contrast the helpless plight of the varicose vein sufferer, which characterized his past, with the bright future which is destined to come for him out of the alert and early application of the injection method.

The reason for the great prevalence of this condition is found in the fact, that as human beings, we are all predisposed primarily to varices by virtue of our upright standing posture. If this were not maintained, the other etiological factors would produce a negligible effect.

Next in importance, endocrine insufficiency would seem to bear more than a contributory relationship to this condition. The varicose diathesis, a state of fragility of the walls of the veins that predisposes them to expansion under pressure, has been mentioned in the

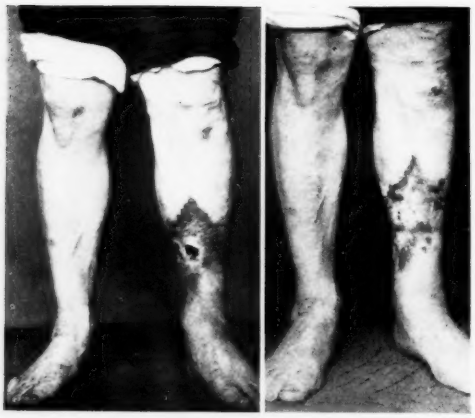

Fig. 6, left. Man 68 years old with generalized varices of left leg and marked secondary tissue changes with œdema and ulceration and deep induration encircling the leg.

Fig. 7. Same patient 3 months later with varices atrophied, ulcer healed, and œdema disappeared.

literature. Thus there are certain individuals who appear inherently predisposed to varices. There is a history, in such cases, of varices in their family through one or more past generations. It occurs in both sexes, but in girls most frequently, most conspicuously at the age of puberty and progresses slowly and independently from then on, as if by its own tendency to progress, rather than as the result of a continuation of the original cause. The onset of varices in women is closely associated with pregnancy. Twenty, or 52 per cent, of the 38 cases who had born children in this series, gave a definite history of onset at the time of pregnancy. Failure to note this in many of the records would probably indicate a higher percentage of relationship. It is frequently observed that varices begin to form as early as the second and third month of pregnancy when intra-abdominal pressure has not yet increased. During the early puerperium, the varices gradually become less conspicuous and the vessels regain their tone. In subsequent pregnancies, the condition advances to a greater degree each time, until finally there remains no ability for the vessel to contract and the varices are permanent and progressive from then on as an independent condition. In 2 patients after the ninth and thirteenth pregnancy respectively, although noticing the onset of varices in their fifth pregnancy, there was a sudden gain of 70 pounds in weight concomitant with equally as sudden an advance of the varices to a tremendous size. Where they were localized before, they suddenly became generalized to involve all the superficial veins of both legs and thighs. Both of the patients were about 5 feet tall, in their thirties, weighed between 220 and 240 pounds on admission and presented an endocrine insufficiency syndrome. In both puberty and pregnancy other evidences of endocrine insufficiency have been noted, as in the transient enlargement of the thyroid gland along with changes in the emotions, vitality, and activity of the individual. Likewise the state of the endocrine system plays an undoubted rôle in the hereditary tendency to varicose veins as well as in the etiology of varices associated with pregnancy and puberty, by determining the state of strength or tone in the musculature of these veins. Since dilatations in the venous system have been frequently noticed in association with acromegaly, an insufficiency of the pituitary gland has been considered by Sicard, Gangier, and Forestier. They have combined pituitary therapy with local treatment. Forestier states that varices accompanying pregnancy are not due, as it was first assumed, to the compression of the pelvic veins through the dilated uterus, but to transitory troubles of the endocrine glands which tend to disappear after delivery.

Contributory causes are as follows: Occupations requiring standing in one position, thus losing the pumping action of the muscles of the leg on the deep veins (mail carriers, though on their feet much of the time, are said to be relatively free from varices); anything raising the intra-abdominal pressure, as repeated straining or coughing; severe febrile disease associated with marked general asthenia in which the musculature of the vein wall becomes atonic and dilates as soon as the patient stands (one case occurred after typhoid fever, another after 5 weeks in bed following removal of a pus appendix; in both instances the varices occurred in both limbs soon after standing and were associated with no other symptoms in the venous system); tight elastic

about the limb, especially in the warmer months when smooth muscle tone in the surface of the body is unusually lax. However, mechanical obstruction appears to play a minor rôle in etiology.

PATHOLOGICAL ANATOMY AND PHYSIOLOGY

There are no valves in the venous system between the opening of the inferior vena cava into the heart and the saphenofemoral junction. Normally, the venous pressure is greatest throughout the body in its periphery and lowest at the heart. In the saphenous system, this condition is not only true, but in addition, a hydrostatic pressure proportionate to the distance between the heart and the level of the feet, is acting in increasing amounts at the lower levels regardless of the condition of the valves. This pressure is transmitted through the successively lower segments of vein, with the valves perfectly competent until the greatest effect of the hydrostatic factor is experienced in the lowest segments.

In occupations and disease that cause an increased intra-abdominal pressure from straining or coughing, the venous pressure is greatly increased throughout the body. While the stronger first sets of valves in the thigh would seem to feel the brunt of this, yet the pressure is even greater at the lower level and the transmission of this added increase in pressure, repeated frequently, gradually forces the valves and the walls of the veins of the leg to stretch, with final incompetency of the valves. The statement usually found in representative textbooks, and which is made so recently as in one of our late systems of surgery, that the varicosity forms from above downward by the breaking down of the first set of valves in the thigh and followed successively by incompetency of the lower ones, is not borne out by observation or the physiology involved. Varices are seen most frequently and earliest in the veins over the inner aspect of the calf of the leg where the veins, by nature of their thinner walls and weaker valves, first suffer from the factors that are at work.

The condition then progresses slowly or rapidly depending on the degree of retrograde flow in the involved segment. If this be great, the support from under the valves above is removed and they break down successively from below upward until the entire great saphenous system is eventually involved.

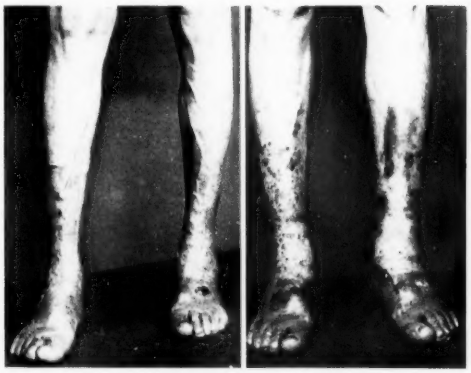

Fig. 8, left. Marked bilateral varices of both legs with extremely advanced superficial secondary tissue changes. Note ulceration on dorsum of left foot and between the toes. Symptoms of stasis and engorgement of subcutaneous tissue and skin were intense in this instance so that the patient was unable to walk about.

Fig. 9. Same patient as in Figure 8, 2 months later. All veins are atrophied. Ulcerations are healed though still crusted. Symptoms have all disappeared. Patient walks with complete comfort again.

Normally the circulation in both the superficial and deep veins of the lower extremity is directed to the heart. This is accomplished in the standing posture by the rigid support given to the deep veins by the muscles and fascia lata surrounding them and by the valves in both these sets of veins and their intercommunicating veins. These valves prevent back flow from the higher levels and are so placed in the communicating veins that the blood flows from the superficial system to the more active deep system in times of strain. There are four to six such communicating veins in the leg and they act as a check valve on the pressure in the superficial system.

In the great saphenous system which has become varicosed and has lost its valves, the circulation is static in the recumbent and retrograde in the standing positions. The blood flows from the superficial veins of the leg, through the communicating veins, up the deep veins, and is spilled over again into the great saphenous vein at its femoral junction. So long as the communicating veins remain

Fig. 10. Ulceration and sclerosis so advanced as to involve all soft tissues down to the bone and surrounding the entire lower half of leg. All veins obliterated with improvement in ulcer to stage pictured, beyond which no further healing can be made to occur by any means known.

competent, immense varices may be present without appreciable change in the nutrition of the leg. Swelling is usually negligible if any, and no ulcer or pre-ulcerous condition occurs. The symptoms which may be present are usually quick fatigue of the legs, tense aching, dragging sensations, and some itching of the skin.

This condition is not destined to continue long, however, in any given case. With the over work of the deep circulation and the constant increased pressure within it, the valves of one or more of the communicating veins break down, which then produces a focusing of stasis in this area both from within and without. The changes consequent to this are œdema and pigmentation of the skin, followed by a slow sclerosis of the part which is common to all malnourished tissue. Ulceration may form early or late in such an area, depending on the degree of stasis and the amount of care taken in prevention.

Thus is explained why so few symptoms and no ulceration may accompany severe advanced varices over the entire limb, while more local varices may be associated with most advanced secondary tissue changes. The competency of the communicating vein supplying a given area is the all important factor after varices have formed. It has been the experience of all surgeons who have performed many radical excisions of varices together with excision of the ulcer, to have found a tremendously dilated communicating vein extending inward from beneath the center of the base of the ulcer. Certain tests will be described later that conform, in the information they give, to this operative finding.

Thus the effect, as well as the curative failure, of elastic stockings is also accounted for in the relief of ulcers, while none of this elastic support is usually used or required without these secondary changes present. Due to this elimination of the portion of stasis caused by the superficial varices, the ulcers and other secondary objective and subjective manifestations improve, but not in proportion to the amount of superficial stasis relieved, because the incompetent communicating vein continues to be unaffected by this measure and drainage of the part is very little improved.

The deep veins are almost never varicosed, and their insufficiency is most rarely a part of the picture described, the result of any of the factors so far mentioned. This is accounted for by their anatomical relationships. When insufficiency of the deep veins is present, it is due in most every instance to a previous panthrombophlebitis, causing a condition known as *phlegmasia alba dolens* (milk leg). The condition is quickly recognized, usually without tests, by the continued unremitting swelling of the ankles and legs dating definitely from the occurrence of the acute condition after pregnancy, typhoid, or septicæmia from other causes. The symptoms and signs are always more striking and persistent and out of proportion usually to the superficial varices present.

However, a test may be applied to confirm the diagnosis of the deep circulation. No other test used affords any direct information concerning the deep veins. A well fitting elastic stocking is worn or an elastic bandage is applied firmly, so that all the superficial veins of the leg are closed by the pressure. The patient is told to walk continuously for 30 to 45 minutes. If the deep veins are incompetent,

obstructed, or closed off from some pathological condition within them, a sufficient portion of the return circulation is thus cut off to cause a decided aggravation of the symptoms and in some cases violent pain. If no discomfort is experienced with the bandage, one may be sure the deep veins are functioning properly.

The Trendelenburg test does not reveal the condition of the deep veins, as was generally believed, but rather the condition of the communicating veins, and, therefore, does in no way decide for or against treatment of the varices. The patient's limb is elevated in the recumbent position until the superficial veins are emptied of blood. With a tourniquet applied high around the thigh so that the veins only are compressed, the patient is asked to stand. If the veins fill up suddenly from below, the communicating veins are incompetent. If they fill suddenly with a gush, only after the tourniquet is removed, incompetency of the valves of the great saphenous vein is demonstrated as is also the retrograde flow of blood within it. With ulcer and other advanced soft tissue changes the first result is invariably obtained and is no contra-indication to obliteration of the superficial varices as was formerly taught. It is rather an added indication for their treatment.

A striking test, first described by Perthes, is also used to demonstrate the condition of the communicating veins. With the superficial veins dilated and distended in the standing position, a tourniquet is applied about the upper thigh, sufficiently tight to compress the surface veins (30 to 50 millimeters of mercury). The patient is asked to move up and down on the toes 20 to 40 times. If the varices diminish in size, competency of the communicating veins, as well as the deep veins, has been physiologically demonstrated. Removal of the tourniquet then allows the blood to flow downward to distend the varices again. This first and positive result could be demonstrated in all cases showing no signs of advanced stasis, but the test revealed a negative result when applied to patients presenting old ulcers and large chronic indurations. In either case the varices are treated in the same manner if the deep circulation is normal.

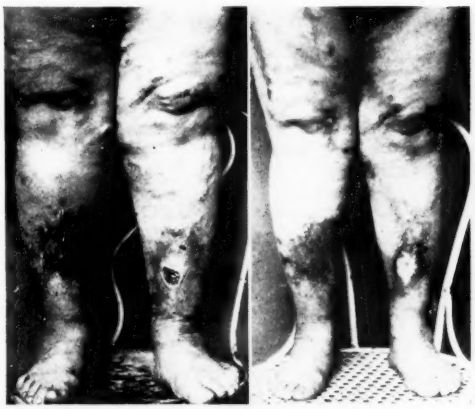

Fig. 11, left. This pictures one of the two patients described with etiology associated with endocrinopathy of pregnancy. The patient is 40 years old; weighs 250 pounds; and is 5 feet tall; has had 13 pregnancies; suddenly gained 70 pounds weight after last pregnancy at which time all the superficial veins over both limbs became varicosed. The ulcer is of 1 year's duration.

Fig. 12. Same patient as in Figure 11, 6 months later. Treatment was completed after paper was submitted for publication. The several varices at upper margin of ulcer were injected first. The ulcer became dry and free of exudate at once and healed in 4 weeks with no special care. A total of 45 injections were necessary to close all of the varicosities that covered all portions of both limbs. Endocrine therapy was begun at once and has continued to date. All symptoms of varicose veins have disappeared, the patient has lost 40 pounds weight, and no more subjective symptoms of endocrine deficiency remain. Not the smallest varicosity remains over this patient's limbs, a result unobtainable by any other method.

PATHOLOGY

Whether from a primary dilatation of the vein wall or a primary breaking down of the valves, depending on the etiological factors, the changes in the vein that accompany varices are the same. The vein becomes gradually more distended and the wall more stretched until, due to malnutrition of the wall, the muscle layer disappears. The stretching occurs longitudinally, as well as circularly and the vein becomes a sacculated, fibrous walled tube.

This scarring and stretching of the vein blends imperceptibly with the areas of secondary indurations about it so that in advanced cases the only vein wall which remains is that which forms a roof over its canalizing burrowing passage through the indurated area. Even here, the entire lumen is lined with endo-

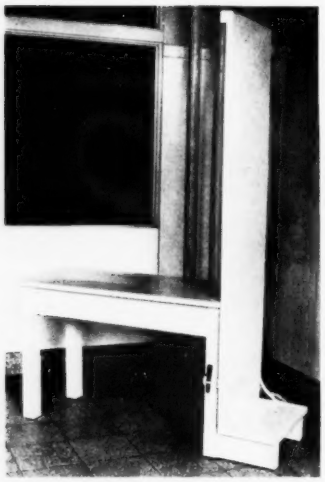

Fig. 13. Table designed by us for the injection of varicose veins. Its use has simplified the treatment greatly. It has advantages over other tables described, in that the patient stands during the insertion of the needle which remains connected to the syringe containing the fluid during the entire operation. Veins on the thigh and posterior aspects of thigh and leg are thus readily accessible. The center of gravity is placed so that the patient is changed from the upright to the recumbent position by one hand of the attendant. The patient does not move a muscle or change position during the operation. This shows the table in the vertical position ready for insertion of needle with veins distended.

thelium, though the edges of the vein are marked only by the sharp precipitous edges of the scar tissue about it.

The complications of varices are all manifestations of venous stagnation followed by chronic malnutrition. Skin changes are among the earliest and are represented by a scaly atrophic condition, hyperkeratosis, and in some cases an active eczema. Moderate œdema is common. The soft tissues become indurated by diffuse fibrosis. Ulcer either forms spontaneously over this, or as the result of a slight trauma. The favorite site of ulceration is a few centimeters above the internal malleolus. Its course is usually very rapid due to the poor resistance in this preulcerous area. Cellulitis in varying degrees of acuteness often develops and the infection may continue on into a phlebitis of the superficial veins. A periostitis may be present over the tibia or fibula with or without ulcer.

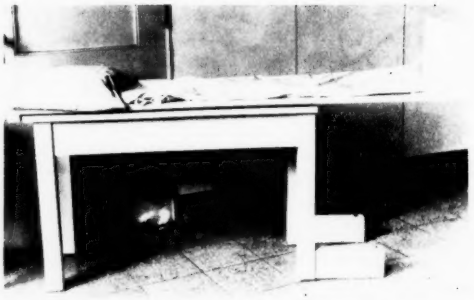

Fig. 14. Table in horizontal position. The change is regular and steady so that the position of the needle is not disturbed. Injection is made in this position. Thus the technique is rendered neat and accurate for varices anywhere on the lower extremities.

CONSIDERATIONS IN TREATMENT

In early cases when certain contributory causes are discovered, these should be removed. Endocrine dysfunction should be treated if possible. It is in these early cases that the injection treatment finds a field of usefulness shared with no other method of treatment before known. The patient with the first localized patch of varices in the leg naturally refuses operative removal of these when told others may form. They do not as yet cause symptoms and the patient is quite willing to wait until they do. Palliative measures only retard in a small way the inevitable progress of the condition. The next time a physician is consulted, it is usually for the complications of an advanced stasis and after the insidious tissue damage has become irreparable. The prevention of all the complications of varices lies within the province of the injection treatment by relieving the patient of the varices as they occur or as they may be discovered in our routine examinations.

In the late cases, operation is often impossible because of the advanced malnutrition of the lower half or two-thirds of the leg. It is true that all the varices in these cases may be obliterated by the injection method and the ulcer not heal completely. The local tissue change has advanced so far as to become a permanent condition independent of the varices. In these cases, improvement always occurs, however, commensurate with the re-

lief of venous stasis and the degree to which it still influences the picture. Often in such cases, living is made bearable again where amputation was the only alternative in the way of operative treatment.

Between these two extremes lies the greatest number of patients for whom the veins are disfiguring or who are suffering in varying degrees from the presence of varices. In this group all but the traces of secondary complications disappear and the ulcers heal as if by magic under the injection treatment. Economically the treatment has its advantages. The patient need lose no time from his activities and there is no hospital expense. The absence of a scar gives a perfect cosmetic result. The varices successfully treated can never recur, although others may form in other veins later, just as it was the tendency of the patient to form the first ones. These may be treated as they occur. In the meantime the extremity has been protected from the complications of stagnation which would have progressed.

The contra-indications to treatment by the injection method are few. Obstruction or incompetency of the deep venous return with its associated extensive œdema definitely contraindicates injection. Not only will the already severe symptoms be made definitely worse, but the danger of gangrene following is great.

Active thrombophlebitis contra-indicates treatment only until all symptoms and signs have disappeared according to some workers. In the experience of others, 10 years should be waited after the last exacerbation before injecting the veins. When it is considered that 7 of the 11 deaths reported in association with this treatment were due to emboli from a bacterial thrombophlebitis, it makes one overcautious. It is much more logical and safe to refuse treatment to the occasional case presenting this condition, than to take a chance on so violently activating an old phlebitis.

For the same reason focal infection should be looked for and if present eliminated before injection. The injury to the vein wall by the injection definitely lowers its resistance to metastatic infection and a bacterial thrombophlebitis may ensue.

In pregnancy, at least 3 months should elapse after delivery before injection is done. This will allow for as much natural involution of the varices as is possible.

Diabetes should be treated before work on the veins is begun.

Collateral varices, such as are seen extending up over the abdomen from the circumflex tributaries of the saphenous vein, indicate an obstruction to the inferior vena cava or the iliac veins and definitely contra-indicate any treatment by injection. The flow in these veins is active and to the interest of the individual.

Arterial disease of the extremities such as Raynaud's disease, thrombo-angiitis obliterans, and endarteritis are conditions which should receive primary consideration in treatment as their symptomatology will overshadow any symptoms of the varices.

Several patients over the age of 65 were treated in this series and stood the treatment perfectly. A careful physical examination should be made in all cases, however, before treatment is begun to ascertain signs of debility, cardiorenal disease, focal infection, and the possibility of venous obstruction in the pelvis.

TREATMENT

Solutions. Solutions which coagulate the blood are dangerous and should not be used. One death is reported with Pregl's solution which comes under this group. Destruction of the intima is the property of solutions desirable in this treatment.

Of all the mineral substances that have been found capable of obliterating the varices, sodium chloride, glucose, quinine and urethane, and sodium salicylate have won greatest favor. Forestier still reports the use of red mercuric iodide in some of his cases.

Sodium chloride in 20 to 40 per cent strength is popular with some workers. Injections are quite painful and the danger of slough formation more marked than with other solutions.

Greensfelder reports tachycardia and cardiac irregularities in one patient 60 years of age, following each injection of 5 cubic centimeters of 20 per cent sodium chloride solution. He concludes that patients of advanced years with slight tendency to cardiac irregularity may be adversely affected by sodium chloride

injections. Of the 10 fatalities in association with this treatment, as reported in McPheeter's review of the literature, sodium chloride was used more than any other solution and sodium salicylate in none. This is in all probability only a coincidence, since in all of these cases but one, death was not directly due to embolus formed by the injection; but rather due to localization of the infection already present in the patient, or to the introduction of infection from without causing a secondary bacterial thrombophlebitis with embolism.

Invert sugar is used in 50, 60, and 75 per cent strengths, 5 to 10 cubic centimeters per injection. There is no sensation of discomfort at time of injection. Results in this series were very irregular and not dependable. In 9 patients 10 cubic centimeters of 75 per cent invert sugar were injected with 6 failures and only 33 per cent success. The solution is thick as a syrup in this concentration and is difficult to force through the fine needle. Its stickiness renders it unpleasant to work with. However, in the only injection in which sodium salicylate failed, invert sugar succeeded in obliterating the vein in one injection. So it is of definite value in a small per cent of the cases. Greensfelder, using 20 per cent sodium chloride and 50 per cent glucose in dogs, obtained only 20 per cent successful thrombosis with glucose as compared to 100 per cent success with sodium chloride. In our experience, in solutions weaker than 75 per cent, invert sugar is not efficient enough to warrant its use, while in 75 per cent strengths it is a valuable adjunct in the treatment of certain cases. Glucose is contra-indicated in diabetes.

Quinine hydrochloride and urethane must be used in amounts not exceeding 6 cubic centimeters in the concentration necessary. Even so, quinine idiosyncrasies warrant its guarded use. Also, its efficiency is limited because of the small amount which may be safely injected since the amount of vein obliterated depends quantitatively on the length of vein wall which may come into contact with the solution in proper concentration.

Sodium salicylate has proved so efficient, dependable, and safe that we have used it in preference to all others in our work. It is used in 20, 30, and 40 per cent strengths in amounts from 5 to 30 cubic centimeters per treatment. In no instance at any age did symptoms of salicylism occur, other than an occasional statement that the drug could be tasted when the larger amounts of the stronger solution were used. There is a burning stinging sensation through the veins as it enters and this is sometimes followed by a cramp in the calf muscles. This all passes away suddenly within a minute of its onset. In nervous hyperemotional patients who react to pain poorly, an hysterical collapse may occur, but in no instance did complete syncope follow. When explained to such patients that pain, in itself, can do no harm and that, in this instance, it results in a definite benefit, they are quite willing and anxious to receive further injections. Many patients give no indication of this brief discomfort. The complications resulting from sodium salicylate are minimum. The veins become slightly painful and tender to pressure and remain so during the time that the changes most actively occur in the process of its obliteration. In our experience sloughing does not occur if a few drops of the 20 or 30 per cent solution escape into the tissues. McPheeters mentions the possible idiosyncrasies to it similar to that to quinine and states the maximum dose in any case should be 3 grams. In this series there has been no indication of idiosyncrasy thus far and doses up to 8 grams have been given with no intention of going higher. In all the literature, no fatality has been reported in association with the use of sodium salicylate although it has been used more than any other solution in by far the greatest number of cases treated, due to its favored use in the French clinic of Sicard and Forestier.

Technique. The area over the vein to be injected is cleansed with iodine and alcohol. With the varices distended in the standing position, a 23 gauge needle on a 10 cubic centimeter syringe is inserted into the varix at its lowest point above the ankle. The needle must be very sharp or difficulties will arise. If a drop of blood is easily drawn or runs into the syringe, the latter is disconnected from the needle and the patient is put in the recumbent position. After the varices are emptied of their blood by a slight elevation of

the leg, the fluid is drawn into the syringe and the syringe reconnected to the needle. (This disconnection during change in position of the patient is to safeguard the position of the needle in the vein during the irregular maneuvering of the patient. A special table is being constructed at present by which the patient will not be required to move a muscle between the standing and recumbent positions. This step will then be eliminated in the procedure.) Again a trace of blood is easily drawn into the fluid to be sure of the needle's position in the vein and with the heel of the foot held about 6 to 8 inches above the level of the table, the fluid is injected rather quickly, but without force, into the collapsed varix. An alcohol sponge is placed firmly over the site of injection and bandaged into place by 3 inch gauze which lightly covers the leg and maintains a collapse of the varices. The patient is allowed to rest for 30 minutes without moving a muscle of the leg. The patient may then go home and about his duties, and is instructed to sit down and keep the leg elevated whenever possible during the next 24 hours. The bandage is removed the following morning by the patient in his home. Injections are best made not oftener than every 48 hours at which time as much thrombosis has occurred as will. The next injection is made just above the level of obliteration obtained in previous injections.

Explanation of principles. No veins of the foot are injected because of the irritation of wearing a shoe over the resulting thrombotic masses which would project above a nonresilient surface. Also, the communication between the superficial and deep veins of the foot is most freely active and the danger of obliterating both deep and superficial systems is great. The varices of the foot give little trouble after the great burden from above is removed and many of them undergo atrophy.

If the fluid cannot be injected without appreciable force the patient will quickly complain of intense pain and burning at site of injection indicating the needle is out of the vein and the fluid in the tissues. Since only a drop or two of the fluid causes this, no injury results. It is best to select another vein entirely for injection after the vein has once been entered and lost.

Fluid may escape into the tissues through the opening in the vein around the needle in very thin and superficial veins. This usually causes a small dry black eschar of the skin with a mild cellulitis beneath. This can be prevented when suspected, by infiltrating the tissues with physiological normal saline. Infiltration of the tissues with the fluid can be detected readily by placing the finger of the other hand over the point of the needle as one injects. If the tissues remain soft and the vein, filled with fluid, remains discretely palpable, the injection is continued with confidence. To wait for blanching of the skin and œdema to appear because of fluid in the tissue is unnecessary and unwarranted.

No tourniquet is used above or below. The firm solid separation between the superficial and deep systems which is furnished by the fascia lata and muscles within is sufficient to keep the fluid in the path of the negative resistance peculiar to the superficial varices. The fluid injected is of such amount that it does not begin to equal the capacity of the varices.

The recumbent position is maintained for 30 minutes to keep the fluid in the varices as long as possible. Absence of muscular action prevents it from being pumped into the deep veins. As the fluid gradually dissipates itself into the general circulation, it becomes diluted beyond effect. If it retains its sclerosing concentration for the full length of the saphenous system, it immediately is diluted as it enters the femoral vein by the blood as it actively passes the saphenofemoral junction with no possible effect on the femoral vein.

No more than one injection is made into a single varicose system in one treatment. As many as five injections, each into varices which do not anastomose freely, has been made in one treatment.

The strength of the solution used depends on the type of varix treated. The 20 per cent solution is efficient in early cases in which the vein wall has not undergone advanced fibrous changes, also when the nutrition of the vein and tissue immediately about remains good.

In advanced cases, with marked secondary tissue changes and where the vein wall is thin and atrophic, the reaction to the solution is reduced, and up to 40 per cent strengths must be employed. Experience quickly teaches one the strength of solution indicated in the various types of veins in any given case and thus reduces the number of failures due to injection of too weak a solution.

Where the varices are immense and generalized, with an enormous capacity, and are intercommunicant by large sinuses, then the larger amounts of solution are used up to 20 cubic centimeters of 30 per cent in one injection. Often, in such cases, the entire varicose system will be thrombosed up to the femoral ring in one injection, with no forther treatment necessary.

Mechanism of action. Forestier describes very accurately the pathology in the vein resulting from injection which causes the final fibrous obliteration of the vein. Three degrees of reaction were also found to occur in this series. First, a simple thickening of the vein wall without obliteration occurred in a few instances where too weak a solution was used. Second, complete occlusion of the vein without perivascular reaction occurred in the majority of instances, in which the vein presents a solid cord without inflammatory signs, 24 to 48 hours after injection. Third, complete occlusion with perivenitis occurred in a few cases especially reactive to the solution. The irritation extends through all three coats of the vessel and into the soft tissues beyond. The area about the vein is painful, swollen, somewhat indurated, pink in color, and possesses increased surface heat. Elevation with cold applications relieved the transitory inflammation in each instance within a few days.

The sclerosing fluid has no coagulating action in the blood, but due to its caustic action on the intima, causes an injury to the endothelium varying from an irritation to a necrosis of these cells. Congestion, a mild exudation, and all the early signs of inflammation follow. The exciting agent having passed on and disappeared entirely, the forces of the blood are not called upon to destroy infection as in bacterial thrombophlebitis, but mobilize merely to heal the injury done. Fibrin is deposited on the walls of the injected vessel. The regular process of thrombosis follows until the lumen of the varix is obliterated. This usually occurs within the first 12 hours and often as early as the first hour after injection.

According to experimental work done by Greensfelder on dogs, the thrombus is hyalinized in 3 days; fibrosis is well begun in 7 days; and advanced organization is present in 14 days. Polymorphonuclear leucocytes appear in the subendothelial layers in the early stages, but the process early and quickly changes from that of an acute inflammation to one of healing *per primam*, due to minimum of injury and the absence of further irritation, chemical or bacterial. The adhesive qualities of the fibrin in the absence of infection between thrombus and vein wall, make of the entire cross section a confluent solid mass, with organizing granulations rapidly moving inward from the periphery, finally to convert the whole into a solid contracted fibrous cord. The thrombus can only form where vein wall is injured and cannot propagate because of the absence of bacteria or other irritants necessary to such a process.

Compare this with the picture of bacterial thrombophlebitis, with its purulent reaction; its bacteriolysins and cytolysins; its liquefaction and separation between clot and vein wall; the propagation of the thrombus indefinitely because of the bacterial irritant within; and the impossibility for organization and healing until the pent up infection is destroyed. Then we realize that the results of injection possess none of these qualities and likewise none of their fears.

There is always a theoretical danger of embolus in the injection treatment, but an analysis of the pathology reveals the reason it has not proved a practical danger.

The process occurring in the vein following injection bears the same relation to a thrombophlebitis as an operative wound healing by first intention bears to one healing by suppuration. In the former there are no signs of inflammation or discomfort other than those which accompany the early adhesive organization of healing. In the latter, however, suppuration and all the signs and symptoms of

inflammation occur with separation of the wound edges.

This difference in pathology is likewise seen in the clinical pictures related to the veins. The reaction in the vein following injection, which has been designated by Forestier as "venitis," is localized in a selected segment of functionless vein, develops a very adherent clot, gives rise to no pain, general œdema, or other inflammatory signs in the limb, does not propagate beyond its original limits, and finally remains as an atrophic fibrous cord.

In phlebitis, the infection and thrombosis frequently spreads to the deep veins causing painful œdema and cellulitis; the clot remains separated from the vein wall by increasing amounts and propagates into the lumen beyond; and the vein does not atrophy, but tends to remain hard, bulky, and a locus of chronic infection which predisposes to further attacks. That the fear of embolism, as experienced with phlebitis, is not in accordance with the pathology of venitis which positively has no tendency to embolism is a conclusion corroborated by all workers with this treatment.

RESULTS

In 104 cases treated by this method, 417 injections were given, an average of 4 injections per case. In many early as well as advanced cases, one injection obliterated all of the varices in the one extremity. In one case 14 injections were necessary to effect a cure in both limbs. Invert sugar in 75 per cent solution succeeded in the one injection where 40 per cent sodium salicylate failed. All of the varices in every instance were obliterated and disappeared. Some remained prominent and sensitive in their hardened state for several months, but disappeared in time.

Only one case failed to show improvement in symptoms. In this elderly patient, the soft tissues of the entire body were extremely flabby and veritably hung in sacculated masses from the bones in any position. It is likely that this case represents a rare condition of a varicose incompetent deep circulation due to lack of muscular support. The œdema and pains in the ankles continued in the same degree after all the superficial varices had disappeared. Elastic stockings benefited this patient none whatever and a poor deep circulation should have been suspected.

In this series 49 (96 per cent) of the 51 ulcers present were healed during or soon after the treatment of the veins. The two ulcers which failed to heal showed definite improvement up to a certain point, but had advanced to a state independent of the varices which had originally caused them.

Of the complications which resulted, perivenitis occurred in 7 or 1.6 per cent of the cases. This disappeared in each instance in from 4 to 14 days after its occurrence with no special care necessary. A slough was obtained in 2 or 0.4 per cent of the cases. These occurred among the first cases treated when the technique was not yet well perfected. In each instance, liquefaction undermined the indurated skin about the vein for 5 to 8 centimeters distance. The vein wall, resistant to liquefaction, became a foreign body. The cavitated area was opened widely and the free segments of vein removed from its center with subsequent rapid healing.

No septic phlebitis nor signs of embolism occurred in any of the cases treated. Infection is not so likely to be introduced by proper technique as it is to develop following a recent thrombophlebitis or from metastatic infection from a distant focus.

Improvement either in appearance, symptoms, or both is so striking, and in many instances after the first injection, that these patients return to the clinic the most enthusiastic and grateful for the relief of what before meant either operation or daily suffering for them.

McPheeters has published a statistical survey in which of 6,771 surgical operations for varicose veins, 35 postoperative deaths from pulmonary embolus occurred, or 0.53 per cent. Of 53,000 cases treated by the injection method, only 4 fatal pulmonary emboli have occurred, or a mortality rate of 0.0075 per cent.

Meisen reports more than 2,000 treated cases without a fatality. Sicard and Gaugier report 120,000 injections in 15,000 consecutive cases with no mortality. Delater reported 890 cases, Douthwaite 2,000 cases, and Genevrier 4,000 cases without a single fatality.

Kilbourne, after a careful comparison of statistics in the two methods of treatment, states that after giving the excision method every possible advantage in the comparison, the mortality rates favor the injection method overwhelmingly. There is no dissension of opinion in the literature on this score.

In the same article Kilbourne reviews the statistics regarding recurrences. In 1,400 patients treated by the excision method recurrences were noted in approximately 30 per cent, after 2 to 5 years. In almost 35,000 cases treated by the injection method, recurrences were noted in only 5 per cent of the cases after 3 years.

Neither treatment is directed to the prevention of forming new varices, but of the two methods after treatment had been completed, these statistics show recurrences with the injection method to be only one-sixth as great as with the excision method.

The fact that the injection method can more completely remove all varices present at a given time, where it is rarely possible to do so by operation, probably accounts for this difference in percentage of recurrence.

No recurrences have been reported in this series to date.

Three patients, who had had extensive operations done 5 to 15 years previously, returned because of advanced recurring varices between the scars. They had refused further operative treatment but received the injection treatment willingly and with an enthusiasm commensurate with their memory of the excision method.

CONCLUSIONS

The etiology, pathology, and physiology of varices of the lower extremities have been discussed with the idea of explaining the progressive character of this condition and to indicate the essential considerations in treatment. A review of the literature together with experience in 104 treated cases indicates that, with careful asepsis and accurate technique, ever mindful of the contra-indications and the principles of treatment involved, the injection treatment of varicose veins can be advised as a safe, economical, and rational method, which may well replace the excision method to the patient's every advantage. Its adaptability to the early case makes it the responsibility of our routine examinations to discover and treat the condition before it becomes advanced. Thus we may hope to reduce in the future, in a large measure, the number of sufferers from the crippling and permanently disabling end results of the untreated condition.

That the treatment may be applied to old and young, rich and poor alike, assures us that we have, at last, a treatment which will reach and relieve the great majority of the sufferers, and through its prevention of associated disability, will prove of real economic value to the individual and the community.

ACUTE PANCREATITIS

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IT is the usual conception that acute pancreatitis, acute pancreatic œdema, or hæmorrhagic pancreatitis, as it is variously known, is an extremely rare disease. Our experience is not in accord with this. The past 5 years have furnished 13 proved cases treated by the senior author. A non-exhaustive search of the literature from 1923 to 1928 yields 232 cases reported in sufficient detail to provide material for analytical study. Schmieden and Sebening, by means of a questionnaire, amassed the total of 1,278 cases operated upon within an 8 year period. The apparently increasing frequency at the present time, the staggering mortality of at least 50 per cent, the unsolved riddle of the etiology, the high index of incorrect diagnosis, and, finally, the lack of unanimity of opinion as to the proper treatment constitute adequate reasons for increased attention to the subject and more frequent consideration of this disease in the differential diagnosis of acute abdominal affections.

INCIDENCE

The reported cases show a slight preponderance for the female sex (59 per cent). There is an almost uniform distribution throughout the third to the sixth decades. It may occur, however, at the extremes of life. Authenticated cases are on record occurring at the ages of 2½, 3, 4, and 7 years, and also as late as 77 years.

ETIOLOGY

In the general series associated biliary disease was noted in two-thirds of the cases. In our own experience it was found in 71 per cent. This undoubtedly is a minimal figure since the presence of cholecystitis or even cholelithiasis often cannot be determined at the time of operation. Further corroboration of the coincidence of biliary and pancreatic pathology is given by the customary history of gall-bladder pain or indigestion for a more or less prolonged period before the acute attack of pancreatitis. In 96 histories providing information upon this point, 62 noted epigastric or right hypochondriac pain of at least a year's duration. Although it is admitted that acute pancreatitis may occasionally arise precipitously without warning symptoms just as perforation of a peptic ulcer may occur without previous indigestion, nevertheless, it is proper to regard the vast majority of cases as extensions of pre-existing biliary tract infections rather than as a fulminating pristine disease. This sequence of chronic cholecystitis and acute pancreatitis is too common and too important to be ignored.

Experimentally the lesion has been reproduced in animals by a variety of methods. To reproduce the lesion we are confronted with two main problems: (1) we must learn the nature of the substance which produces premature intraglandular activation of trypsinogen; (2) we must learn the mode of access of this substance to the pancreas. In an effort to establish the former a variety of substances have been injected into the pancreas or its ducts. Claude Bernard, in 1856, recorded the use of bile in the first of these experiments. Flexner, in 1906, noted that a solution of taurocholate rapidly produced an extreme hæmorrhagic necrosis. By the addition of mucin or some other bland substance such as agar-agar, he was able to ameliorate the severity of the lesions produced. He also successfully used solutions of acids, soda, formalin, and zinc chloride. Archibald revived this concept of the protective influence of mucin. He was unable, however, to demonstrate any significant alterations in the proportions of mucin and bile salts in the bile in cholecystitis. In addition, he confirmed the work of Nordman, who demonstrated that the injection of infected bile produced lesions far more consistently than did sterile bile. Brocq used sterile bile. He collected it, however, either during the digestive phase of the animal or following the administration of secretin.

Pólya, in 1906, injected duodenal contents or a strongly active trypsin solution with resulting pancreatic necrosis. Numerous investigators have injected pathogenic organisms alone. They have reported only mild disease processes or none at all. Cultural studies have likewise been unconvincing. The process appears to be primarily a chemical autolysis rather than an infection. All of the recorded experiments involve the common factor of trauma to the pancreatic tissue incident to forcible injection. That trauma alone may be the inciting factor is well demonstrated by a case reported by Holmes. A sailor died of typical hæmorrhage pancreatic necrosis 3 days after sustaining an abdominal injury in a fall between decks. The only safe conclusions to be drawn from these experiments are that the introduction into the pancreatic duct of almost any irritating foreign substance together with damage to pancreatic cells, traumatic or otherwise, will produce activation of enzymes and consequent tissue autolysis.

Concerning the mode of access of the activating substance, the discussion centers about whether it is by means of the pancreatic duct or by the lymphatics.

Two other routes, namely, direct extension and the blood stream, are conceivable but have seldom been given serious consideration. Deaver (5) reported 2 cases of subacute pancreatic involvement by contiguous extension from a peptic ulcer. The blood stream is generally regarded as only a theoretical source. Nevertheless, certain factors are suggestive. Pancreatitis may occur in the course of an attack of mumps. Operative or postmortem verification of this has been reported by Sabrazes, Lemoine and Lapasset, and Farnum. Moreover, McCrae has observed the occurrence of acute pancreatitis as a complication of typhoid, scarlet fever, diphtheria, and smallpox. However, it is noteworthy that abscesses rarely appear in the pancreas in pyæmia.

Opie, in 1903, first proposed the etiological theory of obstruction at the ampulla of Vater with regurgitation of bile into the pancreatic duct. His deductions were drawn from a case of Halstead's in which a large stone was impacted at the ampulla. Mann and Giordano, in a careful study of 200 autopsy specimens, estimated that the anatomical arrangement of the ducts necessary for the conversion of the common bile and pancreatic ducts into a common channel by an obstruction as postulated by Opie obtains in only 3.5 per cent of individuals. They made further interesting experiments in determining the pressure in the biliary system. The pressures necessary to produce lesions by injections were in excess of any obtained under physiological conditions. This would seem to discredit all the injection experiments previously alluded to by showing that *in vivo* adequate pressures cannot be obtained. It is to be noted, however, that they used sterile rather than infected bile for their injections. Archibald is a firm exponent of the ductal hypothesis. He mentions three factors: (1) a spasm of the sphincter of Oddi, (2) an increased pressure in the biliary system, and (3) the introduction into the pancreas of bile with an abnormal composition.

Maugeret abroad and Deaver, Pfeiffer, and Sweet in this country, are proponents of the lymphatic origin theory. They base their contentions upon (1) the frequent coincidence of biliary disease, particularly cholelithiasis; (2) clinical cures following cholecystectomy and common duct drainage without direct attack upon the pancreas; and (3) obvious defections in the theory of the opposing school. The sequence of events, according to these writers, is lymphangitis of the gall-bladder wall, involvement of lymph channels about the cystic and common ducts, lymphadenitis at the head of the pancreas and, eventually, involvement of the gland itself. Graham attempted to demonstrate the feasibility of such retrograde lymphatic extension. After ligation of the cystic duct and vessels, he traced methylene blue injections from the gall-bladder wall to the pancreas. The recovery from the pancreas of hæmolytic streptococci injected into the portal vein was taken as further confirmation of lymphatic progression. Kauffman, however, in a repetition of the latter portion of Graham's work, demonstrated identical lesions in other organs and regarded it as a bacteræmia.

It may be gathered that no definite conclusion has been reached regarding the exact

mode of origin. Jones may be near the truth when he suggests that there are two forms of the disease. A mild variety associated with cholelithiasis of long standing may originate via the lymphatics. The severe form with early massive hæmorrhages may conceivably result from ductal entrance of the mysterious noxa.

PATHOLOGY AND PROGNOSIS

The original description by Fitz, in 1889, of the pathological details has never been surpassed. Certain features, however, are especially intriguing to the surgeon at the operating table. The brownish peritoneal exudate and the patches of fat necrosis have been widely commented upon. No one, except Linder and Morse, refers to a peculiar greenish-tinged œdema of the mesentric, omental, and retroperitoneal tissues in proximity to the pancreas. We have often observed this. It is encountered in the early cases before hæmorrhage and necrosis have developed. Its dissimilarity from any other intra-abdominal lesion is striking.

The influence of advanced pancreatic disease on prognosis is indicated by Table I compiled from the literature.

TABLE I.—PROGNOSIS IN ADVANCED PANCREATIC DISEASE

Pathology	Cases	Mortality Per cent
None except fat necrosis	4	25
Pancreatic œdema and fat necrosis	42	24
Pancreatic hæmorrhage or necrosis or both	61	65
Gangrene	7	71
Abscess	6	33

The small group of cases with abscess are included because they presented acute symptoms prior to operation. Most abscesses present the picture of subacute or chronic pancreatitis.

DIAGNOSIS

Diagnosis is rendered difficult by the protean manifestations of the disease. The usual textbook description is that of a fulminating abdominal calamity accompanied by profound shock. This, however, fits only one group of cases—the hyperacute variety (Deaver). There is a wide range of milder grades. Not infrequently associated acute biliary symptoms may dominate the picture to the exclusion of the pancreatic syndrome. So bizarre are some of the guises of acute pancreatitis that, in the case reports we have studied, a correct pre-operative diagnosis has been made in only 31 per cent. Among the conditions simulated are acute cholecystitis, acute intestinal obstruction, perforated ulcer, and acute appendicitis. Sometimes no other diagnosis than that of an acute surgical abdominal condition is possible. If one believes that immediate operation is indicated in acute pancreatitis, refinements of differential diagnosis are superfluous. The correct diagnosis manifests itself by bloody peritoneal exudate and fat necrosis the moment the abdomen is opened. On the other hand, if one favors an expectant mode of treatment, accuracy of diagnosis becomes essential.

CLINICAL MANIFESTATIONS

We are indebted to Moynihan for the most picturesque bedside description. There are a a few features to which we would call particular attention. It is customarily stated that the pain of pancreatitis tends to begin shortly after the taking of a heavy meal. It is well known that this holds true for gall-stone colic. In those cases in which there is a combination of cholelithiasis and acute pancreatitis a postprandial onset is very likely. However, it is possible to muster fully as many instances where the onset occurs during the night, in the early morning, or while the victim is at work. The point to be stressed is that a post-prandial pain may signify biliary colic but is not diagnostic or even characteristic of acute pancreatitis *per se*.

Certain features of the pain are distinctive. In 27 per cent of the reported cases there was radiation from the primary epigastric location to the back at a corresponding level. Other favorite reference points are one or both shoulders (7 per cent) and the left upper abdomen (6 per cent). The pain is severe with a tendency to remissions. Indeed, Moynihan declares that "of all the pains the human body can suffer, this is by far the worst." Ogilvie makes the interesting differentiating point that "in acute perforated ulcer the patient never moves from the place where the pain has felled him; in acute pancreatitis,

TABLE II.—

Case	Age	Gall-bladder symptoms	Duration present attack	Location of pain	Radiation of pain	Vomiting	Shock	Jaundice	Cyanosis	Glycosuria	White blood cells	Fat necrosis
1	53	None	6 da.	Epig.	Back and scap.	+	o	+	?	o	23,700	+
2	59	None	3 da.	Gen.	None	+	++	o	+	o	10,000	+
3	47	7 yr.	12 hr.	Epig.	None	+	+	o	?	?	11,000	+
4	55	18 yr.	16 hr.	Epig.	Scap.	+	o	o	+	+	16,000	+
5	37	"Years"	2 da.	R.U.Q.	Back and chest	+	o	o	o	o	23,200	+
6	53	4 wk.	9 da.	Epig.	Back	+	o	+	o	o	7,800	+
7	65	2 yr.	1½ da.	Epig.	Back	+	o	o	o	?	19,300	+
8	50	1 yr.	7 da.	Gen.	None	+	o	o	o	o	29,200	+
9	30	3 yr.	24 hr.	Epig.	None	+	o	+	o	o	23,200	?
10	64	"Years"	24 hr.	Epig.	None	+	o	o	+	o	10,600	+
11	30	3 mo.	12 hr.	R.U.Q.	Back	+	o	o	o	o	19,000	+
12	38	None	48 hr.	Epig.	Back	+	o	o	o	o	27,300 49,500	+
13	42	8 yr.	6 da.	R.U.Q.	None	+	o	o	o	o	13,700	o
14	52	11 yr.	4 da.	Epig.	None	+	o	o	+	o	28,700	+

however, he may go to work after the onset." The contrast between the "frozen" attitude of the patient with an acute perforation and the writhing gyrations of the one with biliary colic is well recognized. The patient with acute pancreatitis assumes a position of moderate relaxation, intermediate between these two extremes. It has been our own observation that these patients tend to favor a right lateral decubitus position. Vomiting is a constant symptom. It is usually persistent. Shock is conspicuous in the fulminant hyperacute cases. It may, however, be entirely absent. A distinctive cyanosis limited to the upper portions of the body was first described by Halstead. It is a slate gray rather than the purplish blue tinge of pulmonary cyanosis. When present, it is virtually pathognomic. It was observed in only 40 per cent of 200 reported cases. In 10 others there was a definite statement of its absence. Doubtless, it was often overlooked. Explanations of its origin are interesting, although unconvincing. Some have ascribed it to a reflex splinting of the diaphragm. A similar splinting occurs in other upper abdominal catastrophes, notably perforated ulcer, but does not in these instances give rise to cyanosis. Others attribute the phenomenon to a toxæmia analogous to that sometimes seen in terminal sepsis. Neither of these explanations is adequate. Nevertheless, the presence of cyanosis is to be regarded as of grave prognostic significance. Where this sign was noted, there were only 6 recoveries in the 40 instances, including several of our own.

The abdominal signs are not proportionate to the severity of the symptoms. Tenderness is constant in occurrence, but somewhat variable in location. Rigidity is seldom marked. A palpable mass is usually found only in late cases and indicates abscess or cyst.

The laboratory offers scant aid in diagnosis. Glycosuria is uncommon, contrary to the logical expectation. There is almost always a leucocytosis and it is often very high. The British lay particular emphasis upon testing for diastase in the urine. We have had no experience with this. The adrenalin midriatic test of Loewe has given us no aid in diagnosis.

TABULATION OF CASES

Bloody exudate	Gall-bladder disease	Condition of pancreas	Operation	Complications	Result	Comments
+	?	Necrosis	Parapanc. drain. Cholecystostomy	Fever 3 wk.	Well 2 yr.	Deferred surgery.
?	Stones	Hæmorrhage	None		Death 6 hr.	Moribund on admission.
+	Stones	Œdema	Parapanc. drain. Cholecystostomy		Death 5 hr.	Operation probably hastened death.
+	Not seen	Hæmorrhage	Drain. of panc.		Death 21 hr.	Too sick for operation.
+	Stones	Gangrene	Drain. of panc.		Death 3 da.	Too sick for operation.
o	Stone	Œdema	Cholecystostomy		Well 3½ yr.	Deferred surgery.
+	Not seen	Hæmorrhage	Parapanc. drain	Pneumonia ventral hernia	Well 1½ yr.	Operation probably beneficial.
+	Stones	Necrosis	Drain. of panc. Cholecystostomy	Pleural effusion—pancreatic abscess	Well 2 yr.	Deferred surgery.
+	Stones	Œdema	Drain. of panc. Cholecystostomy		Well 2 yr.	Operation probably beneficial.
+	Stones	Hæmorrhage	Drain. of panc.		Death 5 da.	Operation justified by suspicion of ruptured viscus.
+	Present	Œdema	Drain. of panc. Cholecystostomy	Secondary hæmorrhage	Death 3 da.	Death from postoperative hæmorrhage.
+	Gangrene	Hæmorrhage	Drain. of panc. Cholecystostomy		Death on table	Operation justified by gangrene of gall bladder.
+	Present	Hæmorrhage	Drain. of panc. Cholecystostomy	Pleural effusion	Well 6 mo.	Deferred surgery.
o	Stones	Œdema	Drain. of panc. Cholecystostomy	Toxic delirium	Well 6 mo.	Deferred surgery.

TREATMENT

It is virtually unanimously conceded in this country that an immediate laparotomy is the proper procedure. Most European surgeons are in agreement. In Denmark, however, dissenting voices arise. Mikkelson has recently quoted Rovsing, Holst, and other Danes as in favor of expectant treatment. They believe that operation is best deferred until the pancreatic symptoms subside unless diffuse peritonitis or abscess formation supervenes. Mikkelson reports the recovery of 50 consecutive cases treated either non-surgically or with deferred operation as compared with a 66 per cent mortality following immediate operation. Among those who favor immediate intervention there is considerable variance as to the type of procedure. Some favor a simple laparotomy with drainage of the greater peritoneal cavity. Others make a direct attack upon the pancreas. Still others confine their attention to the gall bladder and its ducts without any attempt to drain the pancreas itself. Sometimes a combination of methods is utilized. Our custom has been to open the necrotic pockets in the pancreas, by means of either a blunt hæmostatic forceps or a cautery. Soft cigarette drains are then introduced in coffer dam fashion. The tensely distended pancreas is thus decompressed and, at the same time, an exit is provided for the necrotic material. The question of coincident surgery upon the biliary tract has to be answered for the individual case. Although cholecystectomy may, in theory, be the procedure of choice, nevertheless, it is certainly unjustifiable in critically ill patients. Under such circumstances surgical drainage of the biliary tract must suffice until a later date.

Our predilection for immediate operation in acute pancreatitis has been in full accord with the common practice among surgeons. Nevertheless, an analysis of results in our own series of cases herewith reported awakens grave doubts as to the rationality of our position. There appears to be much which substantiates the Danish viewpoint upon deferred operation as previously described. Out of 8 cases operated upon immediately (within 48 hours of onset of attack) 6 died. On the other

hand, in another group of 5 cases in which, for one reason or another, operation was deferred to a later period—from the fourth to the ninth day of the disease—all of the patients recovered. In the first group due credit must perforce be given to the operative procedure in the 2 cases which survived; in 2 other patients justifiable indication existed for performing an emergency laparotomy. (One had gangrene of the gall bladder. In the other an X-ray report of gas under the diaphragm led to a mistaken diagnosis of perforated ulcer. The X-ray appearance was later shown to be due to an anomalous position of the right lobe of the liver and the transverse colon.) In the 4 remaining cases, operation (far from conferring any benefit upon the patient) appeared to hasten the exitus. Three were too ill to survive the shock of operation and 1 succumbed to secondary hæmorrhage.

Immediate operation therefore gave a mortality rate of 80 per cent with no obvious benefits save in the 2 cases which recovered. Deferred operation was followed by recovery in each instance. Our series is completed by a single patient who died without operation within a few hours of his admission. In this small group of cases, the results were strikingly significant.

We wish to add to the list a case which was neither operated upon nor was autopsy examination made. The diagnosis, therefore, rests entirely upon clinical data. Being open to criticism on this score, it has been omitted from the tabulation of the verified cases. The evidence, however, convinced us that this patient recovered from a severe attack of acute pancreatitis.

M. N., female, aged 57 years, admitted to the hospital September 23, 1927. She had had no gastrointestinal symptoms until 6 weeks previously. Coincidently there developed knife-like epigastric pain and vomiting. The pain was intermittent, steadily increasing in severity, aggravated by food, and did not radiate. The vomiting was persistent and bilious. Bowels were regular. There had been evidence of progressive cardiac incompetency for several months. Patient was extremely obese; she was orthopnœic and cyanotic. Her blood pressure was 155–70. Temperature, pulse, and respiration were normal on admission. Entire upper abdomen was tender, no rigidity or masses. Urine was negative; white blood cell count, 22,200; blood urea nitrogen 23 milligrams; blood Wassermann negative; blood sugar 0.117 per cent. X-ray examination by Graham-Cole method showed pathological gall bladder.

In view of the patient's critical condition, the cardiac embarrassment, and the dehydration on admission, operation was deferred. Fluids and glucose were given by bowel, under the skin, and by vein. There was no vomiting after admission, but severe pain persisted. On the following day pain was less severe, but the temperature rose to 101 degrees, pulse was 110, and leucocytes 24,600. There were periods of delirium. On the fourth day a striking improvement was evident. The temperature reached normal almost by crisis. The symptoms subsided. Leucocytes were 5,600. The patient was in good health 8 months after discharge and there had been no recurrence.

COMPLICATIONS

Few surgical procedures are associated with as varied an assortment of inherent complications as operations for acute pancreatitis. Secondary hæmorrhage is common and is a manifestation of the natural hæmorrhagic tendencies of the advanced stages of the lesion. Korte recorded an incidence of 21 per cent. In one of our patients whose pancreas at operation showed only œdema, intractable bleeding from the wound margins and from the pancreatic region began the day after operation and continued until death. The process is one of progressive erosion of blood-vessel walls by tryptic digestion. No treatment appears to avail.

The syndrome described by Whipple and designated "pancreatic asthenia" occurs frequently. It is characterized by asthenia, progressive fall in blood pressure, anorexia, or capricious appetite, nausea, and loss of weight. (The same complication is often observed with associated chronic pancreatitis.) The feeding of pancreatic extract may be of value.

Defective wound healing due to the discharge of pancreatic secretions accounts directly for two common sequelæ; namely, persistent sinus and ventral hernia. For the protection of the wound margins from tryptic digestion, we have used a paste composed of beef extract and zinc oxide ointment with satisfactory results.

The detection of any epigastric mass should arouse the suspicion of a residual abscess or,

if later in convalescence and not associated with fever, of pancreatic cyst. One of our cases developed an abscess in the tail of the pancreas. This was successfully drained by lumbar incision.

Recurrences are reported even after the most radical operations. Bailey records a case with fat necrosis, an œdematous purplish pancreas, and a non-calculous cholecystitis. Cholecystectomy was done. One year later the patient returned *in extremis*. The autopsy disclosed a typical hæmorrhagic type of pancreatitis. We also had a case developing 2 years after cholecystectomy (Case 9 in table). Love observed 28 cases over a period of one year and found that 16 of them had biliary colic similar to that experienced before operation. This return of colic may have been due to stones which were overlooked. In a case of Waring and Griffiths, the shortening of drains on the fifth and again on the tenth day was followed by abdominal pain and vomiting. One of our patients (Case 10) improved after operation, but died following a recrudescence of symptoms on the fourth day. Autopsy showed an extension of the necrosis beyond the limits found at operation.

Diabetes might be anticipated as a sequela of a disease so destructive of pancreatic tissue. Strangely enough, it is rare. This may be due to the fact that the islands of Langerhans are found more abundantly in the tail of the pancreas whereas acute pancreatitis, in most instances, occurs in the head of the gland.

SUMMARY AND CONCLUSIONS

1. Acute pancreatitis is not an extreme rarity and is entitled to more serious consideration than is customarily accorded it.

2. The etiology is not understood although much experimental data has accumulated. Cholecystitis is certainly a prominent factor.

3. The correct diagnosis was made before operation in not more than one-third of the cases reported in the literature. The character of the pain and the appearance of cyanosis are the most distinctive of the diagnostic criteria.

4. The mortality of all the collected cases is 51 per cent. Our own figure (50 per cent) conforms with this.

5. The accepted mode of treatment by emergency laparotomy may not be the best one. Our experience favors dealing with these cases as one would with an uncomplicated acute cholecystitis or an acute salpingitis; namely, deferring the operation until after the acute phase, unless an occasion arises demanding immediate surgical interference.

6. A train of distinctive complications, for the most part incident to operative interference, increases the hazard of early operation.

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OBSTETRICAL ANALGESIA

A Further Study, Based on More Than Twenty Thousand Cases

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IN 1923, while attempting to develop a simple method for the alleviation of the pains of childbirth, I submitted to Dr. Asa B. Davis, chief surgeon of the Lying-In Hospital, New York, the following conditions, believing that any method developed under these conditions would be fair to the patient as well as to the originator:

1. To employ only drugs in common use, so that any pharmacist or physician could readily prepare them.

2. To devise a method so simple, requiring neither specialized technique, unusual equipment, nor trained personnel, that it could be used either in the home or in the hospital, and by any physician, in an entirely empirical manner.

3. To start with a minimum dose of any drug or drugs used, gradually to increase that dose until definite results were obtained, but to modify, stop, or change the technique if either mother or child appeared at any time to be in danger.

4. To publish the results, whether favorable or unfavorable.

Doctor Davis accepted these conditions and agreed to co-operate in the clinical application and development of any method which I might propose, based thereon.

With a definite understanding thus established, I proceeded to make a systematic study of all the analgesics and anæsthetics in the United States Dispensatory and in the standard works on pharmacology and obstetrics, especially those of Sollmann, Cushny, Potter, Meyer and Gottlieb, Polak, and De Lee. A survey proved that no one drug or method was satisfactory, so I decided to test a number of drugs, and to combine them in different ways. Work was begun February 10, 1923, and was continued until standardized a few months later. Many drugs were used, combined in fifteen to twenty formulæ, and most of them were discarded.

FORMULA AND TECHNIQUE ADOPTED

Only one of the formulæ employed was published, and this has been slightly modified. This consists, as modified, of:

Quinine alkaloid	gr.	20
Alcohol	min.	40
Ether	oz.	2½
Petrolatum liquid or olive oil q.s. ad.	oz.	4

The final technique involves (1) three intramuscular injections of magnesium sulphate, each of 2 cubic centimeters of a 50 per cent solution; (2) an injection of morphine sulphate, ¼ grain, *given with the first injection of magnesium sulphate only;* (3) a rectal instillation of the above formula.

DRUGS USED

Magnesium sulphate. The principle of synergism is employed in the use of magnesium sulphate. Meltzer states that a small amount of magnesium sulphate, insufficient in itself to produce anæsthesia, is added to a small amount of ether, also insufficient in itself to produce anæsthesia, and the resultant effect is deep anæsthesia, but he did not prove the synergism, nor did he state the amounts of the drugs used. Hooper (8), using watery solutions of definite proportions of magnesium sulphate and ether, and injecting these solutions into the internal saphenous vein of the rat, separately and combined, proved that the resultant effect of magnesium sulphate and ether is synergistic for analgesia, but addative as to toxicity, hence the margin of safety is large.

Magnesium sulphate synergizes with morphine (3) *by prolonging* its effect, increasing its effectiveness 200 to 500 per cent. It synergizes with ether (5) by decreasing the amount of ether used. From animal experiments it was found that 2 cubic centimeters of 50 per cent magnesium sulphate solution, injected intramuscularly, is at least *100 times removed from the fatal dose* (8). It is the safest of all the drugs used.

De Lee states that many babies have been lost by the administration of morphine *within the hour*, but all authorities, including De Lee, are agreed that morphine and scopolamine ("twilight sleep") do not increase fetal mortality. Harrar (9) says: "With scopolamine and morphine pushed to the degree required for perfect amnesia while we had no more stillbirths we had too many alarms." The effect of the morphine is usually worn off when the child is born, but if not, its depressant effect on the fetal respiration is counterbalanced by the ether in "obstetrical analgesia."

Quinine. This is a safe drug. If omitted, the method is a failure. In the rectal instillation, quinine is absorbed in the blood and appears in the urine. Fifty consecutive analyses gave 45 positive results. The fatal dose is stated as 8 grams (128 grains), but 30 grams (480 grains) have been recovered. One and one-quarter grams (20 grains) and no more is administered at one time with this method. In the dosage used quinine will not initiate labor, but it "stimulates the contractions and increases the tone of the uterus," according to Sollmann, (15) who further says: "Satisfactory results have been reported from its use in all stages of labor. If weak contractions are present, they are intensified." Meyer and Gottlieb (13) state, concerning quinine, that it may be regarded as "a drug which may be safely used to produce uterine movements in the initial stages. The activity of the movements is said to be strengthened for a longer time than with pituitrin."

Alcohol. Only sufficient alcohol is used to dissolve the quinine.

Ether. Ether has the widest latitude of safety of any of the general anæsthetics, i.e., the difference between the anæsthetic and the toxic dose is greater. Greater muscular relaxation is obtained with ether than with nitrous oxide, ethylene, chloroform, or ethyl chloride. Pulse, blood pressure, and respiration are all above normal during surgical anæsthesia. But for the nausea and vomiting following its use by inhalation methods, no other anæsthetic would be thought of. This disagreeable feature is eliminated when ether is given per rectum; furthermore, the relaxation of the muscles is increased, including the cervix uteri. The higher cerebral centers, the intellectual faculties, are never as deeply affected when ether is given per rectum as when given by inhalation. In the amount used, analgesia and amnesia occur, but never the relaxed tongue or jaw, requiring the constant attention of the accoucheur or the presence of a trained anæsthetist. Hence, as is frequently done, the obstetrician, being informed as to the progress of labor, may telephone the nurse when to give the rectal instillation, thus conserving his time and immediately relieving the patient of pain.

Petrolatum liquidum, heavy (or olive oil). Used as a solvent instead of water, this drug diminishes the bulk and absolutely prevents irritation. In over 14,000 cases at the Lying-In-Hospital, the rectum and colon have never been washed out afterward, and yet a slight diarrhœa or blood stools have occurred in less than a dozen cases. These were undoubtedly caused by a pre-existing colitis or fistula in ano, or other diseased condition of the rectum. The percentage of such cases is so small that it would be extremely unwise to subject every woman to a proctoscopy. The slight transient burning sensation when the mixture is first introduced is probably caused by the passage of the ether and quinine through the mucous membrane. If this explanation is correct there is probably no way of remedying the matter.

DEVELOPMENT OF THE METHOD

But for the broad and open-minded attitude and the skilful direction of Doctor Davis, and the co-operation of himself and his associates in the hospital, and the helpful criticism of the house staff and nurses, this work could never have been brought to the successful completion that has been reached. A printing press on the premises for printing charts, instructions, etc., was no small factor in the final issue. A chart was made up, enumerating especially the things in which De Lee and other authorities considered scopolamine and morphine deficient. Other hospitals and obstetricians were urged to use charts[1] so that results might be recorded and *opinions be based on facts.*

[1] A blank chart is always given with the specific directions from the Lying-In Hospital.

Unless something superior in every way to "twilight sleep" could be evolved, the method would be useless. "Twilight sleep" seemed to depend upon amnesia, while suffering during labor was real. The fundamental factor in the present method is *analgesia*, although amnesia is present with the colonic method probably quite as often as in twilight sleep. (No record of amnesia has been kept). Harrar (10) says: "The casual observer would have the impression that there was very little amelioration of the pain, the patient complaining and restless during the contractions, and yet afterward we find the *amnesia* secured to have been as definite as that after scopolamine. Frequently the patient confesses of her own volition that she remembered very little after the rectal instillation was given."

The standard method consists of three intramuscular injections of magnesium sulphate and one retention enema, but in prolonged labor this complete technique, in many cases, has been repeated twice, and occasionally three times, without detriment to either mother or child. In a personal communication, Dr. Henry T. Burns, former house surgeon of the New York Nursery and Childs Hospital, New York, gives a case history of one patient, in labor 57 hours, in which the synergists were used, which finally came to an extraperitoneal cæsarean section. The premature baby was born crying.

REPORTS OF PROGRESS

In accordance with the fourth condition listed above, my first report (6) was published in October, 1923. At that time the term "painless childbirth" was used to designate the method, but this designation merely represented an ideal. In that paper I stated: "The results have varied, but in the majority of the cases the patients have been helped,—the pains were lessened, and in a few a comparatively painless delivery has occurred. Others were not helped in the slightest, while one or two stated that the pains were intensified." The same term was applied to the method in my second paper (7). The term "obstetrical analgesia" was used for the first time as the title of a paper (4) read by me before the New York Obstetrical Society, December 9, 1924. Since that time this term has been accepted generally as defining the state or condition of the patient, and is now in common use.

In 1925, after practically 2 years' experience with the method, Doctor Davis (1) assigned 16 reasons for using the method:

1. Ninety per cent of the patients secure some relief, many a great deal. Poor results are often due to faulty administration and faulty modifications.
2. It can be used as easily in a home as in a hospital. In the Out-Patient Department of the Lying-In it has been given to over 300 patients by the house staff.
3. It is inexpensive, especially when compared to gas oxygen analgesia when given over a prolonged period during labor.
4. It requires no especially trained person to give the actual injection or the actual instillation; any trained nurse can give them. No special attention is required.
5. The physician does not have to be present at all times throughout labor.
6. The drugs recommended by Gwathmey have all been safely tried out in other fields of medicine previous to their use at the Lying-In Hospital.
7. The use of the drugs prescribed by Gwathmey for over 2 years at the Lying-In Hospital in over 1,500 labors, has proved that they are safe in obstetrics. If a cardiac case, or a toxæmia case, or a case of placenta prævia is permitted to go into labor, the use of the analgesia is not contra-indicated. No presentation or position is a contra-indication to its use.

Contra-indications. Colitis, true diabetes, and auditory disturbances are the only contra-indications.

8. The patients are quieter during labor, undergo less strain, and therefore are in better general condition the day after labor is completed.
9. The ether instillation relaxes the perineum so that, if anything, the perineal stage is more rapid.
10. The *intramuscular* injections cause no subsequent painful induration of the muscle as do mercury injections. Abscesses occur no more frequently than with other hypodermic injections. In over 6,000 injections only 6 abscesses developed, and in at least 4 instances these could be traced to faulty technique.
11. By comparative statistics at the Lying-In Hospital, operative deliveries, asphyxia of the fetus during labor, stillbirths, and postpartum hæmorrhages, even if the delivery occurs within 1 hour after morphine-magnesium sulphate injections, are not more frequent than if the method had not been used.
12. When the occiput is in the posterior position labors are usually longer than when the occiput is in the anterior position; the analgesia, however, does not prolong the labor still more in such cases.
13. There is no subsequent rectal irritation, only occasionally a slight burning sensation during the instillation.
14. Vomiting during labor is only a little more frequent than that observed in labors without the analgesia.
15. If it excites the patient she does not have to be forcibly held in bed, as was so frequently the case with twilight sleep.
16. Labors are rarely prolonged.

As the work progressed, charts and instructions were introduced into other hospitals in this city, and later into those of other cities.

and as the results in all of these hospitals compare favorably with those obtained at the Lying-In Hospital, it is believed that we have accomplished, in large measure, what we started out to do, namely, relieve pain, with no increase in stillbirths, and with no interference in any way with the normal processes of labor. The following figures, compiled in December, 1928, amply substantiate this belief.

STATISTICS[1]

	Cases
Lying-In Hospital, New York	
The "Analgesic Record" (Fig. 1) charts for 2 years show that the method is used on an average of 240 times each month (approximately 68 per cent of all cases), [2]or 2,880 times per year; and that for the five years since the method was introduced it has been used in	14,000
(This does not include the private cases, which are not charted.)	
New York Nursery and Childs Hospital, New York	
Between 500 and 600 obstetrical analgesias per year are given, a total for 5 years of over	2,500
Manhattan Maternity Hospital, New York	
Four hundred cases a year, or, for five years	2,000
Cincinnati General Hospital, Cincinnati, Ohio, and private cases of Doctors Crudington, Beatty, and others	2,000

RESULTS

The medication varies in its results from a slight sedative effect to analgesia with unconsciousness, and amnesia. The *progress of labor is not delayed.* Occipitoposterior positions rotate in about the same proportion as in normal labor. Postpartum hæmorrhage is less than with any inhalation method. If anything, the use of forceps is decreased, and the baby, as a rule, is born crying. A former house surgeon of the Out-Patient Department of the Lying-In-Hospital, in a personal communication, stated that the incidence of forceps delivery had been reduced over 50 per cent since the method had been used.

When all of the factors just mentioned are present, i.e., analgesia, amnesia, no delay, baby crying, the result is listed on the chart as "A." If the effect is not sufficiently prolonged or is less complete, it is marked "B." Where the patient is merely helped, or where there is only slight sedation, it is marked "C." Where no relief is obtained, the chart is marked "D."

[1] Information given by superintendents of hospitals named, and by Doctor Crudington for Cincinnati.

[2] Sollmann (*Manual of Pharmacology*) says: "Scopolamin-morphine is applicable in only 30 per cent of all cases."

Morbidity of the mother is decreased, and no fetal deaths attributable to the analgesia have occurred. Certain cases do well with the intramuscular injections of magnesium sulphate alone, or with the rectal instillation alone, but the best results are obtained when the full technique is used. When the patients come in with the cervix four fingers dilated, they are relieved considerably of pain with the intramuscular injections of magnesium sulphate, with or without morphine.

There need be no fear in using the technique in cases of contracted pelvis or disproportion between baby and pelvis where a trial labor is indicated, for many will deliver normally. If they do not deliver, they have a great deal more reserve strength with which to withstand a hard forceps delivery or cæsarean section. Concerning cæsarean section Harrar (11) says: "When one has occasion to perform a cæsarean section under local anæsthesia, an ideal preliminary procedure is to reverse the sequence, giving the rectal ether instillation an hour before the operation and the hypodermic dose of morphine 20 minutes before. This will place the patient in perfect condition to receive the local novocain injections and the analgesia is greatly augmented. Recently we have followed this technique in several cæsarean sections under local anæsthesia, and the absence of suffering on the part of the patient has been noteworthy." In a personal communication Dr. R. J. Lowrie states: "Where labor may seem to be prolonged, there is compensatory increase in the comfort of the patient."

Patients who go through labor with the synergists have less postpartum fatigue and consequently less morbidity. They feel better and insist on getting out of bed early. The Lying-In Hospital has constant supervision over most of their cases for many months before and after delivery, and no contraindication to the method has been noted in regard to after-effects. The method, therefore, has been analyzed from every possible angle. The small amount of instillation, 4 ounces, is easily retained. Careful timing of the different factors secures better control of the distress and pains of labor than is possible by any other known method.

ANALGESIC RECORD

LYING-IN HOSPITAL, MARCH 1927–28–29

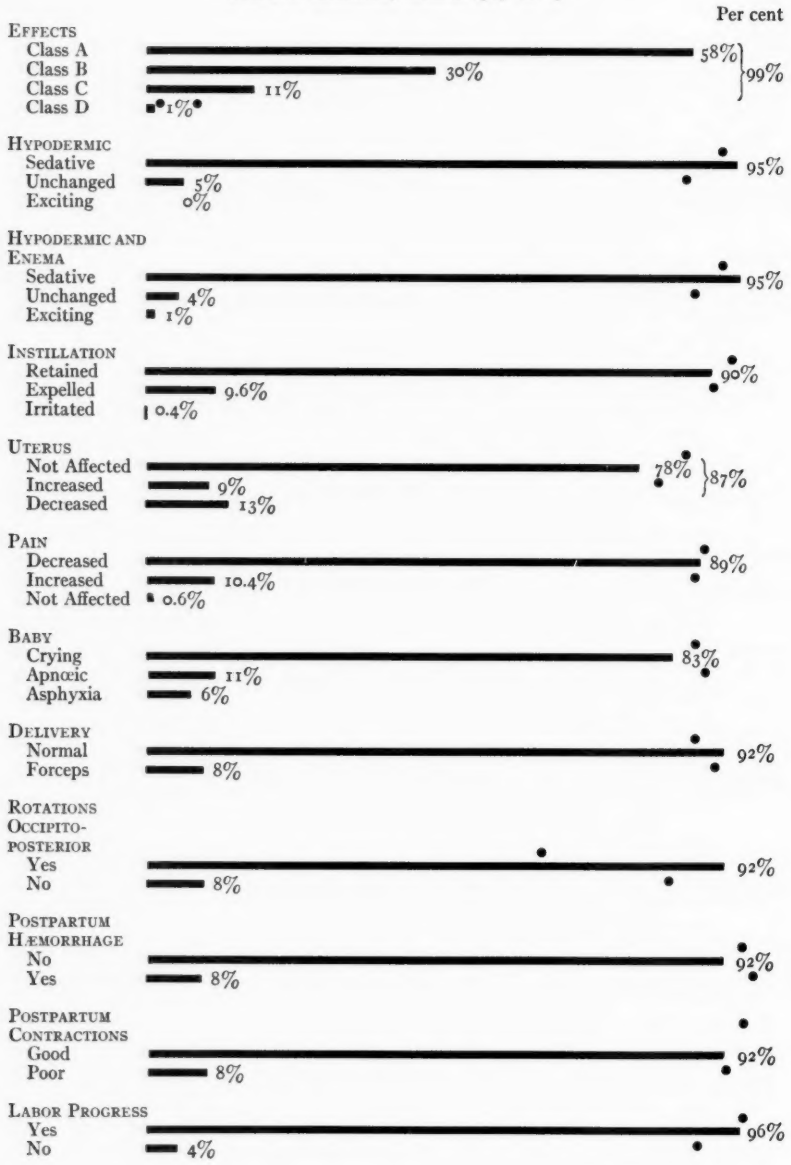

Chart showing standardization of method, arranged from the analgesic records for three consecutive years, for the month of March, each record made by a different house surgeon. The black line represents March, 1928; the dot above the line, March, 1927; the dot below the line, March, 1929. The figures after the lines are percentages.

The house surgeons of the Lying-In Hospital are changed every 4 months, as are also their associates and assistants. Since starting this method it has been in the hands of over 200 inexperienced men, none of whom knew anything of either colonic anæsthesia or obstetrical analgesia before coming to the hospital. The method has been employed over 3,000 times in the Out-Patient Department of the hospital, in the homes of the patients, where it is given under the most trying conditions imaginable, but even under these circumstances it is successful in over 80 per cent of the cases, and no fatalities attributable to the method have occurred. We are justified in stating that it is simpler than any other method, and can be used anywhere. In not a single instance has an anæsthetist been used with the method, even in its initial development. The ingredients are cheap, and the mixture can be prepared easily by any pharmacist, or by physicians who are accustomed to prepare their own medicines.

In the *Annual Report* of the Lying-In Hospital for 1925, Davis stated that he had yet to learn or to observe that any mother or child had been endangered by it. In the *Annual Report* for 1928 he says: "Not long since, 8 patients were seen in two rooms in the hospital in different stages of progressing labor. No outcry was heard. They were being treated with analgesia, and at least relieved of much of their pain. We know of no other safe method of treating such patients which will produce like results."

It is unusual for the attending staff of a hospital to be as unanimous on any medical subject as are the chief and the attending surgeons of the Lying-In Hospital concerning this technique for the relief of pain. Practically every private patient entering the hospital receives the treatment.

CONCLUSIONS

1. Inasmuch as "Obstetrical Analgesia" never reaches full surgical anæsthesia, and was employed by the inexperienced during the period of its development, there is no good reason why it should not continue to be used by them as well as by the expert obstetrician.

2. If mistakes are made, no harm can result to either mother or child.

3. Increased success will come with experience. Those who take the trouble to explain to the patient, and thus secure her co-operation, will obtain better results than those who administer drugs in a mechanical manner.

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HÆMORRHAGE AND "SHOCK" IN TRAUMATIZED LIMBS

An Experimental Study[1]

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THE causes of circulatory failure in surgery are numerous and two or more factors often coexist. Extensive wounds and operative procedures are often complicated by it. In the case of injuries, four of the most commonly considered conditions which might bring it about are hæmorrhage, contused tissues with resultant traumatic toxæmia, injured nerves, and fat embolism. Anæsthesia may also have to be superimposed in connection with treatment. In the case of operations, the most important additional factors are the disease for which the operation is performed and the anæsthetic. There has been a great deal of speculation as to the relative importance of hæmorrhage, contused tissue, injured nerves, and fat embolism in the causation of circulatory failure. It has always been known that hæmorrhage alone will produce circulatory failure, but for more than a century it has been held that a severe injury or operation might bring about a similar picture somehow through its influence upon the nervous system. The term "shock" was first applied to this condition by James Latta in 1795. Since the introduction of this theory there has been a great deal of controversy as to how the changes might be brought about. Most of the earlier explanations offered were very vague. Sir Astley Cooper, Copland, Morris, and Jordan regarded shock as due to general depression of the nervous system through gross mechanical insult. After Claude Bernard's discovery in 1852 of the sympathetic control of the blood vessels, Weir Mitchell, Moorehouse, and Keen in 1865 were the first to regard shock as a reflex vasomotor paralysis. Fischer, in 1870, reasoned from the tapping experiments performed on frogs by Goltz that injury caused a reflex paralysis of the vasomotor nerves with a fall in blood pressure and dilatation of the great veins of the visceral regions. The theory was offered as an explanation of the circulatory failure occurring in connection with injuries both of the abdomen and of other parts of the body. Against the theory of vasomotor paralysis was the discovery of Loven in 1866 that stimulation of the central end of a cerebrospinal nerve caused elevation instead of lowering of the blood pressure.

Crile advocated the view that circulatory failure might result from exhaustion of both the vasomotor centers and brain cells as a result of an excess of sensory impulses from the injured field. Lockhart Mummery also supported the theory of vasomotor failure. However, numerous investigators as Porter, Mann, and Ewing and Janeway, have shown that very prolonged stimulation of somatic nerves in mammals does not bring on circulatory failure.

Meltzer presented experimental evidence in favor of the theory of reflex inhibition as the cause of lowered blood pressure in abdominal operations. He noted that intestinal movements in rabbits seen through the abdominal wall ceased when the overlying skin was incised and remained paralyzed when the abdomen was opened. Howell thought that surgical shock might be due to reflex stimulation of the cardio-inhibitory center.

Little of the recent work has tended to further the cause of the nervous theory as an explanation of circulatory failure in severe injuries. Also we were unable to find reports of autopsies on persons dying of severe injuries, such as the renowned solar plexus blow, in which sufficient pathological changes as hæmorrhage, injury to a vital organ, as brain or spinal cord, or fat embolism were not found to account largely for death. However, it should be remembered that the term "shock," whether used in a popular or a medical sense gives rise to the thought of a severe nervous or mental disturbance produced by psychic trauma, as bad news, in the one case, or by bodily injury in the other.

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THE THEORY OF TRAUMATIC TOXÆMIA

The first evidence that a chemical substance would produce a shock-like state was offered by Heidenhain, in 1891, who found that peptone when injected intravenously in certain animals, produced marked exhaustion, rapid pulse and respiration, and low blood pressure. Dale and Laidlow in 1910 found that histamine when injected intravenously produced a similar but more marked shock-like effect through its vasodilator action on the capillaries and arterioles.

During the Great War, the view became current in the Allied countries that an important factor in the production of circulatory failure in the severely wounded was the formation of a toxic vasodilator substance in the damaged tissues which on passage into the blood stream brought on the picture of circulatory failure which was commonly spoken of as "wound shock." Other factors of varying importance were hæmorrhage, exposure to cold, exhaustion and fright. Delbet thought that the toxic substance might be the product of tissue autolysis. This theory of traumatic toxæmia was supported from the clinical side by Delbet, Quénu, and Fraser and Cowell, and from the experimental side especially by Bayliss, Cannon, and Carnioley and Kotzareff. Soon after the war a great deal of experimental work was published, most of which tended to support the theory of traumatic toxæmia. The results of the clinical and experimental observations growing out of the war are summarized in the valuable treatise by Cannon on *Traumatic Shock*, published in 1923.

CHEMICAL CONTROL OF THE CIRCULATION

Aside from vasomotor nerve control of the blood vessels, there is chemical control exercised by normal constituents of the blood, and of the tissues themselves, or by metabolites formed as a result of altered physiological conditions, either local or general. In the blood there are the hormones, as adrenal and pituitary secretions, acids, bases, and salts, disturbance of the contents of which may alter the state of the circulation. Thus increasing carbon dioxide in a part according to Hooker and Anrep, by increasing the carbon dioxide tension causes peripherally a relaxation of the blood vessels. A discussion of these factors would lead too far afield, as many of them change only secondarily, but the recital of a clinical case throws some light on the possible rôle of the adrenal gland in the maintenance of vascular tone. A male, aged 38 years, with a blood pressure of 128–82, had tuberculosis of the right kidney. A nephrectomy was performed by Dr. G. M. Curtis, with little loss of blood. Within 2 hours, his temperature went up and his blood pressure started down, and 18 hours later it was 60 millimeters mercury. He was cyanotic but otherwise appeared fairly well. The pressure remained about that level for 12 hours, the temperature stayed around 104 degrees, and he stopped secreting urine. He was then given three doses of 1 cubic centimeter of 1:1000 adrenalin at hourly intervals which produced only temporary elevation of pressure, after which it declined still further and he died 40 hours after operation with the picture of peripheral circulatory failure. Autopsy showed nothing of consequence except almost complete destruction of both adrenal glands by tuberculosis. Cases like this make one feel that in man the adrenals may have something to do with the maintenance of vascular tone despite the evidence to the contrary which may be deducted from animal experimentation. It looks as if this man who was on the verge of adrenal insufficiency from Addison's disease was carried over the threshold by the strain of the operation.

Injury of shed blood by traumatism or by laking from freezing and thawing greatly alters its vascular properties. Handy and Phemister found that re-injection or circulation by means of a vivi perfusion apparatus of several cubic centimeters of slightly traumatized or slightly hæmolyzed blood in the femoral artery caused vasodilation in the limb of a dog, but that these same amounts of severely traumatized or completely hæmolyzed blood caused vasoconstriction when circulated in the limb. We have tested this further by the injection of completely hæmolyzed or severely traumatized blood in small quantities (1 to 50 cubic centimeters) into the left heart or first portion of the aorta, so that it reaches the

general capillary bed in high dilution. It produces a sharp decline in blood pressure which with 25 to 50 cubic centimeters may be as much as 70 millimeters of mercury. But the recovery was always very prompt (one-half to 2 minutes) and when it was injected more gradually the blood pressure would return to the previous level before the injection was completed (Fig. 1). Injections into the right heart produce very much less fall in general arterial blood pressure than those into the left. It seems that passage of the damaged blood through the lung capillaries robs it very largely of its vasodilator property, and passage through the capillaries of a limb completely destroys it. The immediate incompatibility reactions in the blood transfusion may have some relation to this phenomenon, and it was considered as a possible causative factor in low blood pressure from severe injuries where damaged blood is extravasated in the tissue; although if toxins of damaged blood in the tissues entered the circulation, they would probably be detoxicated in the lung capillaries before reaching the general capillary bed.

The cause of the vasodilation is unknown. It was thought that it might be due to a histamine-like substance liberated from the broken down cells, but this is not so, since, when the amount of histamine injected into an animal is increased, the fall in blood pressure becomes more marked and prolonged, whereas very large amounts of extensively hæmolyzed or severely traumatized blood (200 to 400 cubic centimeters) circulated through a peripheral artery do not lower general blood pressure at all and when circulated through a vein produce only an initial fall for 1 to 2 minutes. This paradoxical behavior when varying concentrations and amounts of damaged bloods are injected may be due in part or whole to physical chemical changes, not to a toxin acting on the cells.

That the various tissues of the body normally contain substances with vascular properties is well known. Alcoholic extracts of most tissues contain a vasodilator substance, while according to Collip, acetone extracts contain a vasoconstrictor or pressor substance.

Interference with normal physiological processes in a part of the body may result in the local occurrence of vasodilation, which is independent of nerve supply, since it occurs in limbs that have been denervated, as well as in limbs with intact nerves. An example of this is the vasodilation which occurs in a limb during a period of constriction which completely or even partially interrupts the circulation. On release of the constrictor, reactive hyperæmia develops, the limb increases in volume beyond normal and flushes from the inrush of blood. This gradually wears off in one-half to three-fourths the duration of the period of constriction. The cause of the vasodilation is unknown, but according to the theory of Anrep it may be due to a metabolite found in the tissues during the period of constriction. If this is so, perhaps some of this metabolite is washed out by the venous blood during the period of the hyperæmia. Handy and Phemister tried to demonstrate the presence of a vasodilator substance in the blood collected from the femoral vein during the period of reactive hyperæmia following obstruction of the femoral artery. It was recirculated in the recovered limb from a vivi perfusion flask connected with the femoral artery. If the blood was not traumatized it produced no vasodilation when circulated through the limb; consequently by this method we could not demonstrate the presence of such a substance.

Such a vasodilator substance passing from the limb into the general circulation might cause a fall in general blood pressure. We have observed the blood pressure and pulse rate after release of a constrictor to the thigh of a normal man and have found them to change but little if at all. A blood pressure cuff was applied and the blood pressure raised to 225 millimeters of mercury. When the limb was previously rendered bloodless by the application of a spiral bandage and the constrictor left on for 15 minutes, removal was followed by a very slight fall of systolic pressure; in two experiments from 106 to 102 millimeters within 3 minutes and the pulse rate was changed from 72 to 76. Blood pressure and pulse gradually returned to normal in 8 to 10 minutes. This might easily be accounted for by the return to the limb of its normal quota of blood plus the additional blood drawn in by the reactive

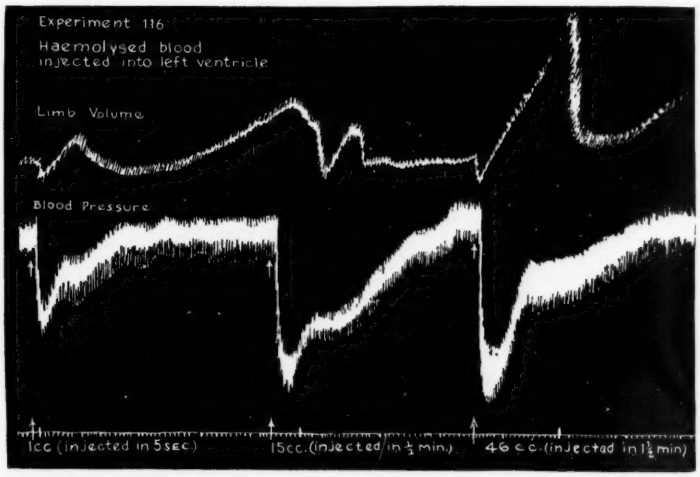

Fig. 1. Fall in blood pressure and changes in limb volume from injections into left ventricle of hæmolyzed blood. The decline from the initial blood pressure of 112 was 54 millimeters produced by 1 cubic centimeter, 62 millimeters by 15 cubic centimeters and 75 millimeters by 46 cubic centimeters. Note the rise toward normal even during the injection of 46 cubic centimeters.

hyperæmia. When the circulation was interrupted repeatedly by rapidly elevating the pressure to 225 millimeters without first emptying the limb of blood, and released in 15 minutes, the blood pressure and pulse rate remained practically unaltered.

In a large number of experiments on animals in which the femoral artery or occasionally the terminal aorta was obstructed for varying lengths of time up to one hour, we have never observed a fall in blood pressure suggesting the entrance of a vasodilator substance into the general circulation. Consequently we do not feel that there is sufficient evidence to warrant the conclusion that after release of vascular obstruction of a part, vasodilator substances producing a fall in blood pressure make their way into the general circulation.

In an extensive study of the responses of the blood vessels of the skin, Sir Thomas Lewis has offered much experimental evidence to support the theory that mechanical, thermal, electrical, photo, and chemical stimulations of the skin liberate a histamine-like substance which causes local redness, œdema, and in extreme cases bleb formation. He believes that the vasodilator substance is liberated principally by the irritated vascularized portion of the epithelium. He thought that in case of extensive irritation of the skin, this vasodilator substance might pass into the blood stream and bring about general circulatory changes. Thus, persons with sensitive skins in whom urticaria factitia could readily be produced were treated by extensive stroking and combing. This resulted in flushing of the face, general rise of skin temperature, and a small temporary fall in blood pressure. He believes that the deeper tissues would respond in this same way to traumatism and that his experiments indicate that the circulatory failure in extensive injuries as well as in anaphylaxis and related phenomena result from the liberation of a histamine-like substance which passes into the circulation and acts on the general capillary bed.

It is an interesting fact that while in the Allied countries "shock" was a subject of great concern, it received very little attention in Germany and Austria. They did not use the term "shock" to designate serious states in the wounded produced by hæmorrhage, infection, exposure, etc. According to Wieting, who wrote an elaborate review of the subject in 1921, the few who believed in it held vaguely to the theory of vasomotor paralysis.

He considers that while such a condition occurs, it is very rare in comparison to fall of blood pressure produced by other factors.

Fat embolism of the vasomotor centers in the medulla as a cause of early shock in war wounds was advocated by Porter both on clinical and experimental grounds. His clinical evidence was very superficial and indirect consisting largely in the observation that "shock" was much more frequent when a fracture formed a part of the wound, which would predispose to fat embolism. On the whole the pendulum has swung far to the side of traumatic toxæmia as an explanation of circulatory failure occurring in wounds and operations regardless of the part of the body that is affected. Thus circulatory failure due to wounds of the extremities and to abdominal operations and injuries has been supposed by some to result from the same cause, although nearly all of the evidence offered in support of traumatic toxæmia is based upon experiments performed on the extremities.

Now that some time has elapsed since these clinical and experimental observations growing out of the war were made, a reconsideration of the subject of circulatory failure seems indicated. Doubt was cast on many of the older theories by the work of Mann in which he found that it was impossible to cause shock by traumatization alone without opening the abdomen, without inducing hæmorrhage, or without injury to the medullary centers. Blalock has recently criticized the loose present day usage made of the term "shock." He considers shock not as a disease but as a group of symptoms which may be produced by a number of conditions including acute hæmorrhage, wounds, and anæsthesia. He has studied experimentally the effects of hæmorrhage and of trauma to the central nervous system on cardiac output, blood pressure, oxygen consumption, and pulse and respiration rates. He found the order of change in a progressive hæmorrhage to be diminution in cardiac output, acceleration of pulse rate, fall in blood pressure, rapid and sighing respirations, stupor and exhaustion, and called the condition "shock due to hæmorrhage." He believes that the fall in blood pressure in injuries of the central nervous system is due both to hæmorrhage and to nervous injury with reflex vasomotor paralysis. He did not suggest that a toxic substance might be liberated from the damaged brain which produced vasodilation upon entering the circulation. He found the venous blood from the traumatized or exposed part, which had resulted in lowered blood pressure, to be higher in oxygen content than in normal controls.

EXPERIMENTAL WORK

The theories of circulatory failure as applied to wounds of the extremities have been tested in a series of 70 experiments on anæsthetized dogs, a preliminary report of which has been published by one of us (E. P.) The anæsthetic employed was: morphine and ether in 24 cases; ether alone in 17 cases; morphine and barbital in 18 cases; and barbital alone in 11 cases. When morphine (0.03 grams morphine acetate per kilo body weight) was used the blood pressure at the beginning of the experiment was usually 10 to 40 millimeters lower than when ether or barbital alone was used. Otherwise the results under the different types of anæsthesia were very similar. We studied the effects of stimulation of the nerves of the limb, of traumatism of the limb, and of bleeding. Blood pressure tracings were made from a cannula in the carotid artery. When trauma was produced the left hind leg was hammered with a two pound padded hammer vigorously enough to bruise and lacerate the soft parts without breaking the skin or bones, except in occasional instances.

NERVOUS THEORY

The theory that wounds of the extremities produce circulatory failure through their effects on the nervous system was tested in 8 experiments by the experiment of exposure and stimulation of the sciatic nerve or the sciatic and anterior crural nerves, by frequently repeated crushings with forceps and by the application of a faradic current. At the beginning of stimulation there was a rise in blood pressure (Loven reflex) which was usually sustained as long as the stimulus was actively applied. In some of the experiments where the faradic current was applied it was kept up for more than an hour. In no instance

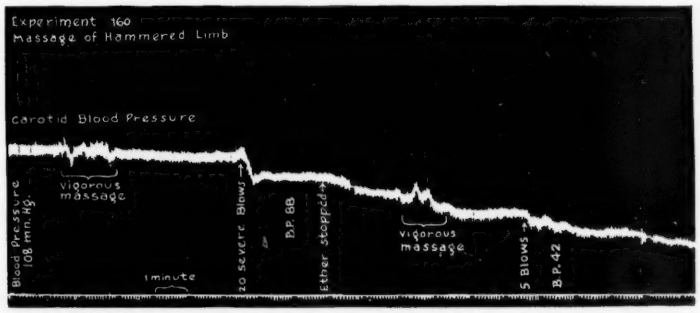

Fig. 2. Limb hammered 45 minutes previously when blood pressure was 120, shows no fall in pressure from massage but a fall from traumatism.

was there a resultant fall in blood pressure. This confirms the observations of most investigators, as Porter, Mann, Janeway, and Ewing.

An attempt was made to determine the rôle of the nervous system in animals where circulatory failure was produced by traumatizing the limb. In 10 experiments the limb was denervated just before traumatizing, and in the others the nerves were intact. When the nerves of the limb were intact, hammering eventually resulted in a fall in blood pressure which was directly dependent on the amount of injury and was as great as in an animal the hammered limb of which had been denervated. It has been claimed that in circulatory failure from injury to the extremities, there are dilatation of blood vessels and stagnation of the blood in the splanchnic areas due to vasomotor paralysis, thereby resulting in a decrease in the amount of circulating blood. We necropsied dogs which died as a result of traumatism of the extremities and found no dilatation or engorgement of the blood vessels of the intestines and other abdominal viscera. On the contrary the intestines were pale. There was no evidence in these experiments that stimulation of the somatic nerves of an extremity causes fall of blood pressure.

TRAUMATIC TOXÆMIA

The theory of traumatic toxæmia was tested in 45 animals with low blood pressure produced by hammering the lower extremity. As a rule in dogs weighing 10 to 15 kilograms, it was necessary to deliver about fifty blows in succession with a padded hammer in order to bring about a fall in blood pressure. The immediate fall was usually not great and sometimes the pressure returned to normal within a few minutes. Two or three hammerings of the same severity are usually necessary in order to bring the pressure permanently to 75 millimeters of mercury or lower. The length of time that the animals lived after this trauma varied greatly from a few minutes to several hours depending on the severity of the injury. When ether was being administered it was usually withdrawn in case the pressure reached a level below 75 millimeters and the animals did not regain consciousness. With the fall in blood pressure the pulse regularly increased correspondingly in rate and the respirations became accelerated and shallow.

If the circulatory failure in this condition is caused by toxic substances formed in the damaged tissues, then massage of the traumatized limb might force out an extra amount of the toxin which would produce a further fall in pressure. However, as a rule it was found that massage or extensive manipulation of the limb produced no fall in pressure (Fig. 2). Sometimes there was a rise in pressure in innervated limbs produced no doubt by the Loven reflex. Rarely there was a fall and this was usually when the pressure was moderately lowered. These findings are in marked contrast to those of Cannon obtained on cats, in which he reported a fall in blood pressure as a result of massage and manipulation of traumatized and fractured limbs which had increased only slightly in volume from the injury, in

some instances as low as 10 per cent. The exceptional fall in blood pressure in our experiments was interpreted as probably due to further hæmorrhage set up by the manipulation, since the animals had passed the critical point where a slight loss of blood would cause a sharp decline in pressure. However, there remained the possibility of a traumatic toxæmia.

The concentration of the blood was determined in these experiments in a search for evidences of traumatic toxæmia. Dale and Richards found that in histamine poisoning there is an increase in the concentration of red cells in the peripheral blood and Underhill has noted the same thing in severe burns. Erythrocyte counts and hæmoglobin estimations were made on the capillary blood of the ear of these dogs and a decrease in the number of cells and reduction in hæmoglobin were regularly found. In no instance was there evidence of a concentration of the capillary blood. The results of arterial and venous counts in one experiment are shown in Table II.

In view of the observation that dilute hæmolyzed or traumatized blood entering the circulation may cause a fall in blood pressure it was thought that damaged, extravasated, and hæmolyzed blood in the traumatized limb might enter the circulation and bring about a fall in pressure. In this event the plasma would be stained with hæmoglobin. Blood was withdrawn from the jugular vein in seven of these experiments and centrifuged, and the plasma was examined for the presence of hæmoglobin. In no instance was it found except in very minute traces. A liberated toxin might be absorbed into the circulation and lower blood pressure without the entrance of hæmoglobin. To test this point blood was collected from the femoral vein of the traumatized limb in a vivi perfusion flask without shaking, as used by Phemister and Handy. It was promptly circulated through an untraumatized limb of another dog after the flask was connected with a cannular system in the femoral artery. It did not produce vasodilation in the limb, and in no case did it cause a fall in general blood pressure.

It is known that alcoholic extracts prepared from various tissues produce a fall in blood pressure when injected intravenously. The depressor effect of alcoholic extracts of muscle traumatized *in vivo* was found to be the same as that of normal muscle removed after death of the dog. The extravasated blood collected from five traumatized limbs was also extracted with alcohol. The extract produced a fall in blood pressure, but it was no greater than that produced by an extract of the same amount of normal blood.

When an animal with a low blood pressure, the result of hammering the limb, was bled, the further loss of a relatively small amount of blood, usually 100 to 200 cubic centimeters, produced death. However, when the blood pressure was equally low as a result of repeated injections of histamine, a proportionally very much larger amount of blood could be withdrawn before death ensued. Thus a 17 kilogram dog the systolic pressure of which had been kept at or below 60 millimeters of mercury for 35 minutes by 4 injections of 10 milligrams of histamine at 10 minute intervals was then bled 615 cubic centimeters before death occurred. These findings fail to demonstrate that either hæmolyzed extravasated blood returning to the circulation or a toxin is the explanation of the low blood pressure of the traumatized animal and favor hæmorrhage as the cause.

It has been claimed that circulatory failure, the result of shock, will not respond to blood transfusion whereas a low blood pressure, the result of hæmorrhage, may ordinarily be restored to normal by blood transfusion. In order to test by this criterion whether or not the circulatory failure produced by traumatism of a leg was due to "shock" or hæmorrhage, two such traumatized animals were treated by blood transfusion and it was found to restore the failing circulation in both cases. Figure 3 shows the blood pressure tracing of a 10 kilogram dog the limb of which was severely hammered, at the beginning of which time the systolic blood pressure registered 130 millimeters of mercury. There was a rapid decline in pressure which remained low, and both heart beat and respiration ceased in 31 minutes. A transfusion of 500 cubic centimeters of heparinized blood was given immediately and artificial respiration was practiced

TABLE I.—COMPARISON OF EFFECTS OF TRAUMATISM OF LEG WITH EFFECTS OF HÆMORRHAGE IN DOGS OF THE SAME WEIGHT

		Dogs dying from hæmorrhage		Dogs dying from traumatizing leg	
Wt. of dogs (kg.)	Estimated blood vol. 1/11 of body wt.	Bled from femoral artery (c.cm.)	Percentage of total blood	Difference between norm. and traumatized legs (gms.)	Percentage of total blood
9	693	320	46.0	436	59.6
10	770	358	46.0	400	52.0
11	847	380	44.0	355	41.9
13	1001	525	52.5	540	54.0
15	1155	519	45.0	683	59.2
16	1272	575	45.0	705	55.4

for a minute and a half. The pulse and respirations were restored and the blood pressure promptly returned to the original level. However, it was found that if the limb of a dog is traumatized until there is a marked fall in blood pressure and the animal is left in this condition for a considerable length of time, the pressure may be restored practically to normal limits by blood transfusion, but the animal will not regain consciousness. The same is true after bleeding. This is due to the fact that the cerebral centers are affected by the deficient circulation quicker than the circulatory and respiratory centers in the medulla and are killed while the latter remain alive. Death of the cerebral centers before the medullary centers is sometimes seen as a result of circulatory failure during operations in man.

In order to determine whether or not toxic substances were formed in devitalized muscle which gave rise to shock the entire right rectus abdominis muscle was excised aseptically and reimplanted in three dogs, intraperitoneally in two and into its bed in one. The animals were observed for 3 weeks after operation and showed no signs of intoxication.

HÆMORRHAGE

The theory that circulatory failure in traumatized limbs is due to hæmorrhage was tested by looking for evidences of loss of blood and by comparing the effects of traumatism with those produced by bleeding alone.

TABLE II.—RED BLOOD COUNTS IN CIRCULATORY FAILURE

	Histamine injections Exp. 234, wt. of dog 9.5 kg.		Hæmorrhage Exp. 258, wt. of dog 19 kg.		Trauma to leg Exp. 243, wt. of dog 11 kg.	
	Arterial	Venous	Arterial	Venous	Arterial	Venous
Onset of experiment	5760000	6100000	5530000	5990000	5220000	5320000
10 min. later	6080000	6110000	5160000	5280000	5230000	5330000
	Injection 10 mg. histamine		200 c.cm. blood from femoral artery		50 severe blows to leg	
10 min. later	5160000	5020000	5150000	5090000	4730000	4320000
10 min. later	6060000	6420000	4030000	4980000	3980000	4690000
	Injection 10 mg. histamine		200 c.cm. blood from femoral artery		50 severe blows to leg	
10 min. later	8400000	9650000	3790000	4290000	3600000	3370000
10 min. later	8250000	8750000	3110000	3190000	3340000	3900000

It was observed that as the limbs were hammered, usually at 15 minute intervals, they swelled, and this swelling increased after the hammering was stopped. The amount of increase in limb volume was determined after death by making symmetrical amputations of the lower extremities along their lines of attachment to the innominate bones, and comparing their weights. It was noted that the increase in weight of the traumatized limb ranged from 310 grams in a 7 kilogram dog to 1057 grams in a 20 kilogram dog. The average increase in weight in 38 experiments in which the animals lived varying periods from ½ hour to 8 hours was somewhat more than that of the blood which, if withdrawn at repeated intervals during a similar period from animals of the same weight, will result in death as shown in Table I. The general symptoms developing in the animals with extensively traumatized limbs were observed and were found to be practically the same as those which occur after hæmorrhage. Severe traumatism produces acceleration of the pulse and of respiration coming on with the fall in blood

pressure. When the blood pressure is as low as 80 millimeters of mercury, the pulse rate is usually 160 or higher and the respirations which vary much with the anæsthesia are 30 to 50 per minute. The temperature usually falls from 1 to 3 degrees C. and the mucous membranes become pale. Examination of the circulating blood shows increasing evidences of acute anæmia which parallel fairly closely those in other dogs obtained by repeated bleedings which lowered the blood pressure to the same level (Table II). When the blood pressure stays below 70 to 80 for some time, the animal is profoundly unconscious and usually remains so after ether is withdrawn. The reflexes gradually diminish and toward the end of experiments, lasting 3 to 4 hours, are usually abolished. At necropsy the general signs of hæmorrhage are found. The mucous membranes, serous surfaces, and viscera are pale, the heart and large veins contain relatively small amounts of blood and as previously mentioned, the intestines are pale and free from engorgement with blood.

The swelling of the traumatized limbs was the result of both hæmorrhage and œdema, and dissections were made in order to determine the relative amounts present of each. The muscles of the thigh were usually found markedly macerated, and there was extensive extravasation of blood which infiltrated both the muscles and the intermuscular septa and formed large collections in the torn regions. Numerous small blood vessels were torn and in instances some of the larger ones, but it was exceptional to find the femoral artery severed. The amount of œdema was relatively small in comparison with the hæmorrhage. Microscopic examination was made of the tissues in a number of experiments. It was found that in some regions the muscle was fairly well preserved, while in others it was macerated. Blood extravasation was marked, especially along the fascial planes and muscle sheaths. Many of the muscle fibers appeared normal. The striations were present and nuclei were well stained. The outstanding cause of the swelling was the hæmorrhage although grossly a moderate amount of œdema was always evident.

Much of the extravasated blood was clotted, but an observation made by one of us (E. P.) was the large amount of unclotted blood which was frequently found at necropsy hours after the limb had first been traumatized. Samples collected in test tubes usually remained unclotted for days. An erythrocyte count of the extravasated blood usually showed fewer cells than the capillary blood at a time when the pressure was low. In one experiment there were 2,380,000 erythrocytes in the extravasated blood, while that from the ear contained 3,110,000 at a time when the blood pressure measured 33 millimeters of mercury. An analysis of the plasma of the extravasated blood showed that there had been considerable hæmolysis. Thus in one experiment there was 8.5 grams per 100 cubic centimeters of hæmoglobin in the centrifuged plasma. The total hæmoglobin content was usually near that of the venous blood. The extravasated blood differs in different regions according to the time in the course of the experiment when it was extravasated. The early extravasations consist of blood that is high in hæmoglobin and red cells while later extravasations are more dilute. The œdema also produces still further dilution and the greater the hæmolysis the lower the red count.

In view of the previously mentioned vasodilator effects of hæmolyzed and traumatized bloods, this marked hæmolysis of the extravasated blood deserves careful consideration as a cause of lowered blood pressure. However, Sellards and Minot injected the supernatant fluid from 30 cubic centimeters of packed red blood cells which were hæmolyzed by the addition of water, then centrifuged and rendered isotonic by the addition of sodium chloride. It produced no fall in blood pressure. Bayliss showed that large quantities, 200 to 300 cubic centimeters of a dog's blood, can be withdrawn, defibrinated, hæmolyzed, and reinjected without producing toxic effects or lowering blood pressure. We have withdrawn 200 to 400 cubic centimeters of blood and replaced it by an equal amount of hæmolyzed blood without causing any permanent lowering of the blood pressure.

The cause of the failure of the extravasated blood to clot has not been determined definitely. Chemically no fibrinogen could

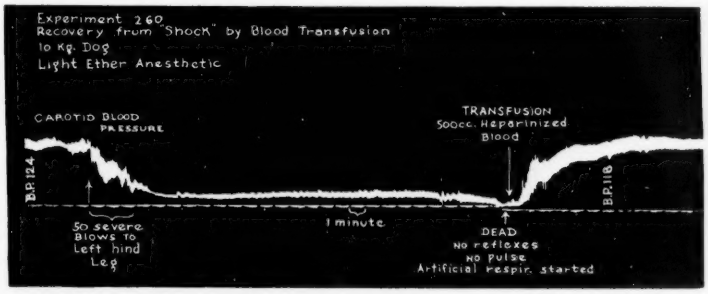

Fig. 3. The response following blood transfusion shows that the circulatory failure was due to hæmorrhage.

be demonstrated by precipitation with the addition of a saturated solution of sodium chloride to the plasma. The blood did not clot when calcium salts or blood serum was added although circulating blood of the same animal from the heart immediately before or after death always clotted in normal time. The addition of a small amount of circulating blood to it caused the formation of a jelly-like clot. It was thought that an anticoagulant of the nature of heparin might be formed. Consequently unclotted extravasated blood and traumatized muscle were extracted for heparin by the method of Howell, but none was found. Heparin has not been demonstrated in normal muscle. This same phenomenon is observed in man in whom large hæmatomata sometimes remain largely unclotted for days.

In a series of seven animals, a constrictor was applied to the limb arresting circulation, after which it was traumatized. No swelling or fall in blood pressure followed. Upon removal of the constrictor the blood pressure fell, but measurement of limb volume and dissection of the limb showed that there was increase in limb volume and hæmorrhage into it similar to that which was observed in case of traumatism in the absence of a constrictor. In two experiments the femoral artery was tied before traumatization of the limb, and only a small amount of swelling and little or no fall in blood pressure resulted. However, on release of the ligature the limb swelled, the blood pressure fell, and marked hæmorrhage occurred into the limb. In two experiments the femoral vein was ligated and the limb was then hammered. This resulted in more rapid swelling and fall in pressure than was the case when the vein was not ligated.

Death from hæmorrhage into the tissues of the limbs without a break in the skin has been observed many times in man. Larkin recently reported 4 cases of this type. It is most often seen in crushing injuries of the thighs where large quantities of blood may be extravasated without the development of sufficient tension in the soft parts to arrest bleeding.

Hæmorrhage in man may occasionally be extensive and produce marked symptoms of circulatory failure with lowering of blood pressure but with little or no compensatory acceleration of rate of either pulse or respiration. This is sometimes seen in ruptured tubal pregnancy. That it may occur in extremity lesions is illustrated by the following case:

A woman, aged 22, was operated on under ethylene anæsthesia for a large hæmangioma of the gluteus maximus muscle. A large amount of blood was lost during the excision which was done in 1 hour. Fifteen minutes later the patient was pale, very weak and restless and sighed frequently. The systolic blood pressure was 46 millimeters mercury. The pulse was very weak but its rate was 76 and the respirations were 16 per minute. After 1200 cubic centimeters of physiological salt solution had been given intravenously the blood pressure remained around 60 for one-half hour but the pulse and respiration rates changed very little. The blood pressure gradually went up to 110 during the next 8 hours and the pulse went up to 90 but respirations remained around normal. That a severe hæmorrhage took place was shown by a blood examination on the third day which revealed 2,700,000 reds, 48 per cent hæmoglobin, and 12,000 whites.

The observation of such cases proves that the rule to the effect that low blood pressure

accompanied by a slow pulse indicates shock while low blood pressure accompanied by a rapid pulse indicates hæmorrhage, does not hold.

FAT EMBOLISM

In 10 experiments in which the limbs were hammered, sections of the lungs were stained for fat with scarlet red and hæmatoxylin. In 7 cases very slight fat embolism was found but in 3 there was a moderate amount. The quantity of fat was greatest in the experiments of long duration. Sections of the heart, liver, kidney, and spleen were made in 7 cases and extremely little to no fat was found in any of them. In 4 cases the central nervous system was examined for fat because of Porter's view that shock may result in fat embolism producing paralysis of the vasomotor center of the medulla. Death occurred in 39, 40, 105, and 135 minutes respectively after hammering and in the last 3 experiments bones were intentionally broken thereby adding another factor favorable to the development of fat embolism. Sections were made of cerebrum, cerebellum, and medulla, and practically no fat was found in the vessels of any of them. The fat that was present in the lungs of some of the dogs may have been a minor factor in causing the fall of blood pressure, but that in the nervous system was too scanty to have played a rôle in any case.

ABDOMINAL EXPERIMENTS

While a discussion of circulatory failure from injuries and operations on the abdomen lies outside the scope of this paper, it should be mentioned that the causes are not identical with those of circulatory failure in traumatized limbs in that hæmorrhage may be entirely absent in the former. This had been noted clinically in some cases. In dogs the blood pressure can usually be caused to fall markedly in 1½ to 2 hours by exposure and oft repeated manipulations of the intestines, and if the procedure is continued death eventually ensues. Experiments are being conducted in an endeavor to determine the cause of the fall in pressure. That it is not due to vasodilation and severe "bleeding into the intestinal vessels" as often claimed, was demonstrated in 7 experiments in which the eviscerated dogs were periodically placed in the upright position and intestinal volume measured by immersion in physiological salt solution. Five of the animals died in from 2½ to 9 hours, the average being 5 hours and 10 minutes. The increase in gut volume ranged from no cubic centimeter to 230 cubic centimeters, the average amounting to 76 cubic centimeters. At necropsy, the increase in volume was found to be due partly to œdema and partly to vascular congestion and ecchymosis. In no case was the amount of blood accumulating in the loops during the experiment sufficient to produce an appreciable decline in the circulation. With the great majority of individual manipulations, there was no change in blood pressure and in no instance was there a rise. In two experiments there was occasionally a sharp fall in blood pressure at the onset of the manipulation with recovery in ½ to 1 minute—a change in blood pressure similar to that after a small injection of histamine. This finding has raised the question of the escape of a vasodilator substance from the manipulated intestines into the circulation, but it has occurred so rarely that it cannot be looked upon as a constant factor producing the circulatory failure. Disturbances in the vasomotor nervous control appeared to be a more plausible factor here than in case of low blood pressure due to traumatism of the extremities.

CONCLUSIONS

1. Traumatism of a limb of a dog producing fall in blood pressure is accompanied by a corresponding increase in limb volume and anæmia which are due very largely to hæmorrhage into the damaged tissues. This is the predominant factor in the production of the circulatory failure. Much of the extravasated blood fails to clot.

2. In these experiments it could not be demonstrated that a toxic substance liberated from damaged or asphyxiated tissues or extravasated blood of the limb was absorbed and produced a sustained fall in the general blood pressure. Therefore, the circulatory failure cannot be regarded as essentially a traumatic toxæmia.

3. There is no indication of the escape into the general circulation of a toxic blood

pressure lowering substance after release of a constrictor applied for 15 minutes to the thigh of man containing its normal content of blood.

4. Reflex vasomotor paralysis or exhaustion did not account for the circulatory failure, since intensive stimulation of somatic nerves produced elevation instead of fall in blood pressure, and equal amounts of traumatism to denervated and innervated extremities produced the same amount of fall in pressure in each.

5. Fat embolism played either no rôle or an extremely minor one in the production of the circulatory failure.

6. It is preferable to speak of hæmorrhage rather than shock or shock due to hæmorrhage when acute loss of blood in wounds, whether closed or open, is the cause of marked circulatory embarrassment or failure.

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THE INFLUENCE OF THE TRANSVERSE UPPER ABDOMINAL INCISION ON THE INCIDENCE OF POSTOPERATIVE PULMONARY COMPLICATIONS

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POSTOPERATIVE pulmonary complications rank high among the major hazards of abdominal surgery. They may occur when least expected and despite every reasonable precaution, or a smooth recovery may follow operation under conditions which appear to be most favorable for the onset of a pulmonary lesion. Because of the uncertainty in incidence, the difficult problem of prevention and treatment, and the serious consequences of many of these complications, they are a source of constant dread to the surgeon. They constitute one of the main obstacles to his free assurance to the patient about the risks of operation. Death from a pulmonary complication in a healthy patient following an operation of election is one of the most distressing experiences in surgical practice. Much interest has been manifested in the subject, especially during the past decade, and several excellent studies on etiology and prevention have pointed the way to a reduction in incidence. But a satisfactory minimum is yet far short of attainment.

Examination of the statistics on several large series of cases from different sources (Whipple, Cleveland, Decker, Cutler and Hunt, Mandl, Elwyn) reveals considerable variation in incidence which, however, attains an average of about 2.5 to 3.5 per cent. Decker states that 1 patient in 45 operated upon develops a respiratory tract lesion and 1 in 200 dies from the complication. It is noteworthy that in successive series reported from the same source, the incidence tends to rise, due probably to better recognition of these conditions. Whipple's interest in the subject was stimulated by noting that many cases showing a sharp rise in temperature on the first or second postoperative day exhibited characteristic roentgen-ray findings before any physical signs could be detected. Furthermore he noted that the physical signs might not appear even until after the temperature had subsided. There is little question but that many postoperative pulmonary lesions have been and constantly are being overlooked because we have been content to accept the indefinite designation of "postoperative reaction."

We are just emerging from a period in which many postoperative pulmonary complications, unless due to such obvious gross lesions as massive embolism and infarction, were loosely designated as "postoperative pneumonia." Discussions on etiology have been fraught with much speculation and there are wide differences in opinion as to the cause and manner of production in a great many of these lesions. Unfortunately, the facts in any case often permit such varied interpretations in theory that we are unable to say by what mechanism the complication has come about. Solution of the difficulty awaits more accurate methods of investigation. Recently, however, there has been a distinct effort to avoid the loose designation of "postoperative pneumonia" and to classify these pulmonary lesions more accurately as pathological entities which we are able to recognize in many instances, such as true pneumonia, embolism, atelectasis, or a combination of these conditions. Thus the ends of prevention and treatment are better served by the effort to determine the route and manner of origin in each instance.

There are undoubtedly many different factors either directly responsible for, or contributory to, the onset of pulmonary complications. It is very difficult to estimate how great a rôle any one factor may play. For many years the irritating effects of inhalation anæsthetics and the frequent lack of skill with which they were administered have received much of the blame. Cutler has been a notable exponent of the theory of embolism from the operative field as being responsible for the majority of these complications. Wharton

and Pierson conclude that embolism is responsible for fully 50 per cent of the postoperative pulmonary complications following gynecologic and abdominal operations. Whipple has well summarized the factors predisposing to postoperative pneumonitis as upper respiratory inflammation, local or general infection, lowered immunity, increased virulence of organisms, and inhibition of normal respiratory movements. In recent years pulmonary atelectasis has assumed an important place in the field of postoperative complications. The condition has been known to medicine for a long period. The literature has been growing rapidly and contains many excellent reviews of its history and experimental and clinical aspects. (Coryllos and Birnbaum, Lee, et al., Mastics, et al., Scott, and others.) There is not universal agreement as to the manner of the production in all cases. However, it has been repeatedly demonstrated both experimentally and clinically that bronchial obstruction by mucus or foreign body with absorption of the imprisoned air is a very frequent, if not the most common, cause. Those factors which tend to interfere with respiratory function and the expulsion of mucus by coughing undoubtedly favor the occurrence of this condition. Recently Coryllos and Birnbaum have made a very suggestive case for atelectasis as a mechanism of importance in the onset of pneumonia including the postoperative type. Elwyn (8) and others are inclined to the same view.

If one examines further the statistics on the incidence of postoperative pulmonary complications, some striking and important features stand out. There is a great predominance of these lesions following abdominal incision as compared with operations elsewhere. Furthermore, the percentage runs much higher in upper abdominal operations and the pulmonary lesion is located more commonly on the right side at the base which corresponds with the greater frequency of right-sided incisions in the upper abdomen. The figures of Elwyn (8) bring out these points clearly. In a series of 2,932 operations under general anæsthesia, the incidence of postoperative pneumonia was 2.76 per cent. The incidence following laparotomy was 6.29 per cent, whereas after operation on other parts of the body it was 0.70 per cent. Following stomach operations the percentage was 13.8 per cent. He quotes the figures of Mandl who noted 10.57 per cent following operations on the stomach. The right lower lobe was involved in 41 of 89 cases, the left lower lobe in 21, both lower lobes in 24, the right upper lobe in 1, right upper and right lower lobes in 1, and right upper and both lower lobes in 1 case. Another series of cases by the same author as well as figures from other sources essentially confirm the above findings.

It has been noted, furthermore, that the incidence of complications following local anæsthesia is quite comparable to that after general anæsthesia. It must be said, however, that many patients are selected for local anæsthesia because of poor condition and especially the presence of some factor predisposing to a pulmonary complication.

The foregoing considerations lead to the inevitable conclusion that incision and manipulation in the abdomen, especially its upper portion, are frequent and very important factors in the onset of postoperative pulmonary complications. In setting forth the contributory factors previously mentioned, Whipple characterizes the influence of the operation as follows:

"Factors inhibiting the normal thoracic and abdominal respiratory movements and favoring atelectasis and hypostasis in the lungs: (a) Trauma to the thoracic and abdominal wall incident to the incision and retraction of the operation causes persistent pain and a splinting of the thoracic or the abdominal muscles of respiration; (b) inflammation of the peritoneum causes the same splinting of respiratory muscles; (c) distention following peritonitis and cœliotomy. This causes a limitation of the diaphragmatic excursion; (d) tight binders and surgical dressings.

"These factors are undoubtedly very marked and account for the very large percentage of pneumonias associated with cœliotomies as compared to operations on the extremities. In this series 88 of the 97 pneumonitis cases followed abdominal incision. Czerny was the first to emphasize the rôle of pain in the abdominal wound as a factor in

preventing sufficient aeration of the lungs and expectoration of mucus in the trachea."

The writers have felt that the influences just mentioned have not received sufficient consideration. In search of some way to modify and lessen this "wound effect" on respiratory function and thereby possibly to lower the incidence of pulmonary complications, it was decided to try the transverse upper abdominal incision in every case in which it was feasible. This incision is well known and has been practiced by many surgeons for various reasons but often with little or no emphasis as to its effect on respiratory function. However, from this standpoint alone, sound physiological principles recommend it.

Transverse incisions early were used for cosmetic effect, as they left a thin unobtrusive scar. At this time the only structures divided transversely were the skin and subcutaneous tissue, the deeper layers being separated by a vertical incision. Moore gives to Maylard the credit for originating the transverse division of all layers of the abdominal wall. Sprengel, however, early became the foremost advocate of the transverse incision pointing out its many advantages. His writing stimulated the interest of Moschcowitz who in 1916 reported his experience with 97 cases and included a comprehensive account of the anatomical and physiological principles involved. The three great flat abdominal muscles, the external and internal oblique and transversalis, have a wide attachment of origin over the lateral and posterior aspects of the trunk. They have a common insertion in a broad aponeurosis passing posterior to the rectus abdominis and interlacing in the midline with a similar structure on the other side to form the linea alba. This aponeurotic insertion is made up of a multitude of fine tendinous fibers having in general a transverse direction. The term "posterior sheath of the rectus" tends to divert attention from the real importance of this aponeurosis which has little significance so far as the rectus itself is concerned, but is of great importance as the structure of insertion of these flat abdominal muscles. The direction of their action varies some in each case but the general effect of all is a lateral pull.

As Moschcowitz points out, the conventional vertical incision violates sound anatomical and physiological principles. Every surgeon sooner or later has a practical demonstration of the fact in the exasperating experience of closing a vertical incision in the upper abdomen especially if the patient strains or is rigid. The flat muscles pull the wound apart and the sutures tear out because they are placed parallel to the majority of the aponeurotic fibers which have been divided transversely. When closure is finally accomplished the sutures probably often pull out in the first few postoperative hours especially if there is any straining or retching. This is very apt to result in massive adhesions and a weak wound.

Many surgeons in addition to those mentioned have recorded their experiences with the transverse incision (Bakes, Meyer, Quain, Perthes). Practically all are agreed that the technique of incision is more tedious and complicated than in the vertical wound. This is more than compensated for, however, by the ease of closure. Straining actually makes suture easier as the lateral pull of the flat muscles tends to approximate the wound edges. Many surgeons have emphasized the superior access which the transverse wound affords in stomach and gall-bladder operations. With this the writers cannot agree entirely, as the upper "shelf" of the wound is an obstacle in the approach to a high deep gall bladder. But more troublesome than this in many cases is the difficulty of access to the common bile duct because the upper "shelf" may interfere greatly with the passage of exploratory probes, forceps, etc. In most of the cases, however, exposure is entirely adequate. It is necessary only rarely but perfectly justifiable to make a vertical prolongation upward or downward at the inner extremity of the wound or to divide both rectus muscles. There is universal approval of the cosmetic result, which is a thin and sometimes scarcely perceptible scar. The late results have shown a low incidence of hernia which usually occurs only when there has been extensive sepsis and necrosis. Of the 97 cases reported by Moschcowitz, 67 were available for examination at the end of

a few months to about 6 years. No hernia was found. It has been pointed out that ventral hernia in a transverse wound is difficult to repair. Sufficient time has not elapsed to report the late results in the cases of this series. To date hernia has been observed in only 1 case. Some operators have objected to the unsurgical practice of dividing the rectus muscle. This apparently does no harm whatever, as subsequent operation has demonstrated that the scar really amounts only to an extra transverse line.

Of all the advantages, however, the one which seems the most significant is the freedom from wound pain pointed out by other observers and the ease of breathing as compared with that in patients in whom the vertical incision has been used. This again is logical from the point of view of anatomy and physiology, because the pull of the great abdominal respiratory muscles tends to approximate and relax the wound and not pull it apart. This must lessen the pain and therefore permit more nearly normal respiratory excursion and lung ventilation. Impressions gained from close observation of these patients have confirmed this view in practically every instance. It is striking to note the comfort and ease of breathing in the average short, obese, patient following a gallbladder operation with transverse incision. Such a patient with vertical incision often gives the impression of extreme discomfort for the first 2 or 3 days, with elevated and restricted or "grunting" respirations and a flushed or slightly cyanotic face. This restricted respiratory excursion, limited lung ventilation, and tendency to voluntary restraint of cough undoubtedly impose conditions favorable to the onset of atelectasis and pneumonia. With the transverse incision, cough and other expulsive efforts are often notably less painful.

This highly probable relationship between the "wound effect" and the complications of atelectasis and pneumonia cannot, however, be extended so obviously to pulmonary embolism. The problem of embolism cannot be discussed at length but many additional factors, the nature and operation of which are still obscure, come into play. It is commonly believed, however, that venous stasis is an important element in the formation of emboli. It is also well known that normal respiratory motion plays a rôle in the return of venous blood to the heart. In so far as this motion is restricted, it might operate with other factors to promote venous stasis and thus increase the tendency to embolus formation. But the relationship between embolism and the "wound effect" is certainly less obvious and important than in the case of the two other major pulmonary complications.

The transverse upper abdominal incision has been used in a series of 125 cases, most of which were operations on the gall bladder, bile ducts, and stomach. In 2 or 3 cases, pulmonary symptoms, such as cough of mild or moderate intensity, were noted without other evidence definitely to establish a pulmonary complication. In 5 cases there were definite pulmonary complications all due to embolism. There were 2 fatalities in which the diagnosis was confirmed at autopsy. In the remaining cases, the onset and course were typical of embolism and infarction with satisfactory recovery. The occurrence of embolism in this series is rather striking, but undoubtedly is to be explained only by factors which lie without the scope of this discussion. It is equally striking that no cases of atelectasis or pneumonia were observed. Thus the total incidence is 4 per cent, notably less than Elwyn's report of 6.29 per cent for all laparotomies and in marked contrast to his figure of 13.8 per cent following operations upon the stomach. When one considers that in the selected group of upper abdominal operations in which the pulmonary complications are highest and that, including the cases of embolism (100 per cent) in this series, they are reduced by 50 per cent or more, it would seem that the foregoing principles have an important significance.

The technique of the incision has been described many times and will be reviewed briefly. The skin and subcutaneous tissue are divided straight across from the midline or slightly beyond to a point which makes the incision lie tangent to, or slightly above, the inferior curvature of the costal margin. At the outer border of the rectus, the flat muscles

are divided in the direction of their fibers and an opening is made into the peritoneum sufficient to admit the forefinger. With the finger in the peritoneal cavity to protect the viscera, two mattress sutures of No. 1 chromic catgut doubled are placed on either side of the incision. These sutures pass through the anterior rectus sheath, the muscle, the peritoneum, and out again. The ends are snapped and held. The muscle is then divided between these sutures securing and ligating vessels before severing the posterior sheath and peritoneum. In closure the posterior sheath and peritoneum are united with a continuous suture of No. 1 chromic catgut and next the anterior sheath in the same manner. Particular care should be exercised to get good closure at the inner extremity of the wound where all structures unite in a single layer. Next, the corresponding ends of the doubled mattress sutures are tied across the incision and the skin is closed. If a drain is used it emerges at an advantageous point in the outer extremity of the wound. As has been mentioned, both rectus muscles may be divided or a vertical extension may be made up or down from the inner extremity of the incision. These modifications are rarely necessary in operation on the gall bladder and bile ducts, but may facilitate such operations as resection of the stomach or splenectomy.

It is realized, of course, that the number of cases is far too small to warrant final conclusions as to the value of the transverse upper abdominal incision in the limitation of postoperative pulmonary complications. The evidence presented cannot be considered otherwise than a strong impression created by clinical observation. But the impression is so suggestive that the transverse upper abdominal incision will continue to be used in every case possible, despite the handicaps which have been noted, until sufficient evidence has accumulated to establish or disprove definitely the relationship which is now indicated.

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RENAL RESECTION; AN EXPERIMENTAL STUDY OF POST-OPERATIVE FUNCTION

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SINCE Valentin first nephrectomized eight rabbits in 1839, and Tuffier (1889) made a surgical study of the animal kidney, much experimental work has been done on the kidney as a whole as well as on a portion of the renal parenchyma. However, little attention has been given to the post-operative function of the resected kidney, especially as regards phenolsulphonephthalein output.

The object of the present work was to investigate, experimentally in animals, various types of technique in renal resection, to observe the incidence of hæmorrhage, fistulæ, atrophy, and compensatory hypertrophy, and to determine the renal function following resections as evidenced by the excretion of phthalein.

The kidney was resected under healthy conditions and without disturbing the opposite kidney. Not enough renal substance was excised to disturb the renal counterbalance (if this occurs) and stimulate compensatory hypertrophy. Theoretically our results should show a parallelism between loss of renal substance and loss of renal function.

METHODS

Thirty-seven dogs were used in these experiments. Of these 2 died under ether narcosis; one from postoperative hæmorrhage and one from peritonitis. Our greatest difficulty after operative recovery was to keep the animals alive and healthy for any great length of time, for they seemed to suffer an increased susceptibility to infection of the air passages.

The dogs were anæsthetized with ether, and the oblique lumbar incision was used to reach the left kidney. The kidney was delivered, the upper pole decapsulated, and then excised by a wedge-shaped incision. If the renal pelvis was opened it was closed with catgut sutures when convenient, otherwise not, since we did not consider it necessary. With an open healthy urinary tract we never saw fistula develop. The capsule was drawn together over the resected end and the renal wound was closed by simple through-and-through sutures of No. 1 catgut, fused in the end of a straight intestinal needle and vaselined. The abdominal wound was closed in the usual way without drainage, and the skin was sutured.

This technique was adopted after a rather painstaking investigation of many methods, particularly the following: The kidney was resected straight across, by a V-shaped incision, with and without stripping the capsule. The V-shaped incision after the capsule was stripped gave the best results. The kidney wound was closed in many different ways: mattress sutures, through-and-through sutures, ligature of individual cut vessels, circular suture of cut surfaces, compression without suture, fat masses under sutures, capsule alone sutured, etc. The through-and-through simple suture as advised by Tuffier after the stripped capsule had been replaced was found to be most suitable. We noticed that if placed deeply, these simple sutures stopped hæmorrhage, did not cut through the renal substance, and produced a minimum amount of atrophy. The straight needles with catgut fused in their heads produced very little trauma, especially if well greased with sterile white vaseline. It was unnecessary to suture the capsule separately. The deep sutures held it in place very well, without further aid. The capsule was of great assistance in holding the suture in place and preventing it cutting through the friable renal parenchyma; and it seemed to be a barrier to late secondary hæmorrhages. We found that mattress sutures were highly destructive to renal parenchyma and produced a maximum amount of atrophy, with a corresponding reduction in the phthalein output.

The dogs were kept for periods ranging from 1 to 34 weeks, when they were anæsthetized with barbital-sodium, given intravenously.

We found that barbital did not interfere with free secretion of urine, while ether often greatly retarded the output. A suprapubic cystotomy was performed, and the ureters were catheterized with Nos. 4 or 5 ureteral catheters. Water was given by stomach tube and normal saline subcutaneously in sufficient quantity to ensure free excretion of urine. Then 6 milligrams of phenolsulphonephthalein was injected intravenously and the urines collected for 1 hour. The dogs were now killed with ether and the kidneys removed, weighed, and measured. The phthalein estimation was now made. The normal phthalein output for 1 hour varied somewhat, but averaged around 70 per cent (35 per cent for each kidney). Mark placed the normal at 80 per cent in 2 hours.

RESULTS

The function of the right, or unoperated upon kidney, remained normal after resection of the left kidney in dogs 1, 2, 3, and 5 weeks old. The dog of 5½ weeks showed an increased function to 50 per cent, which was unexplained, it weighing only 3.0 grams more than the left kidney. The 34 week dog showed normal weight and slightly reduced function (27.5 per cent). Compensatory hypertrophy did not occur. With these two exceptions, the unoperated upon kidney remained normal in function and weight.

The resected left kidney showed a decrease of weight and of phthalein function in all experiments and at all times. The diminished function was most marked during the first 2 weeks after resection, due to congestion and repair processes. A gradual restoration of function occurred in the third to fifth week, never, however, reaching the normal amount. The 34 week dog showed a phthalein of 17 per cent. The weight of the operated upon kidney increased during the first 2 weeks after resection, likewise due to congestion and repair processes. After the third week the kidney slowly diminished in size and weight, until it was smaller than normal. At 34 weeks, one kidney weighed only 11 grams, about one-third of normal, an unusual amount of atrophy. However, in no instance did we encounter total atrophy and complete loss of function.

Five to 10 grams of the left kidney was resected, approximately one-seventh to one-third of the substance of this kidney. The average amount of renal tissue removed was 6.33 grams.

The reduction in function was relatively greater (10.5 to 25 per cent phthalein), approximately one-third to two-thirds the normal. The average showed a phthalein on the left side of 18.7 per cent (52 per cent of the normal). This discrepancy between function and weight was due probably to operative and suture trauma and scar formation.

RÉSUMÉ OF CASES FROM THE LITERATURE

Tuffier showed that after resection, the quantity of urine and urea temporarily diminished or ceased abruptly, then progressively increased, to regain the normal rate by the sixth day. Barth and Wolff each saw little or no hypertrophy of the opposite kidney after renal resections. Rowntree and Geraghty observed a noteworthy alteration in phthalein excretion only when disease had reduced the total kidney parenchyma to less than one-half. Magoun obtained some decrease of phthalein output after nephrotomy. Cash noted diminished phthalein excretion when the total tissue was reduced over 50 per cent.

Young and Davis obtained 5 per cent phthalein excretion from the resected left kidney and 20 per cent from the healthy right kidney, 4 months after operation, a ratio of 1 to 4. Scholl first nephrectomized a functionless right kidney for calculous pyonephrosis and later did resection of the remaining kidney for nephrolithiasis. At the time of resection the phthalein was 40 per cent. One year later the phthalein had risen from a postoperative 15 per cent to 50 per cent. E. Beer did a wide heminephrectomy, and one year later the phthalein output of the two kidneys was as 4 to 7.

Spiegelberg is said to have resected a kidney for hydatid cyst in 1867 (deRouville). Spencer Wells (1884) excised one-third of the left kidney during the removal of a perirenal fibrolipoma. Czerny (1887) resected for localized angiosarcoma, and Tuffier (1891) for a cyst and a renal fistula. Keetly (1890) resected part of a traumatized kidney, and

Bardenhauer (1891) resected for a renal cyst, traumatism, and lithiasis.

Pawlik (1896) was the first partially to nephrectomize a double kidney. Israel, Cramer, and Watson (1896) each resected regions of localized tuberculosis. Kuemmel (1890–1895) did resection for calculous pyonephrosis, ecchinococcus cyst, malignant tumor, horseshoe kidney, and for diagnosis. Bloch (1898) used resection as a diagnostic procedure. Tuffier, Chavannez and Lefevre resected the polycystic kidney. Among the early cases in this country are three by W. J. Mayo, reported by Braasch in 1912.

Bloch collected 10 cases in 1896 and Berti in 1921 collected 113. Since Berti's report we have found an additional 109 cases of resection, making at least 222 cases up to 1928.

INDICATIONS

Renal resection is conservative surgery and may be utilized in certain types of renal pathology. It is indicated when the pathology is localized and benign, the blood supply to the resected kidney adequate, and the operation anatomically possible. It has been practiced in the presence of cysts, benign tumors, double kidney, nephrolithiasis, partial hydronephrosis and pyonephrosis, renal fistula, infarct, localized cortical infection, paranephritic disease, horseshoe kidney, tuberculosis, and to establish a diagnosis.

Among the many indications, renal resection is particularly valuable in calculous disease.

Given a case in which a stone or stones occupy one pole of the kidney, with more or less dilatation of the calyces or destruction of the parenchyma with cavity formation, the removal of the involved segment of the kidney is likely to give a better result than pyelotomy or nephrotomy, particularly because it eliminates the possibility of recurrence.

Resection of the infected part of a double kidney, if the anatomical arrangement of the circulation permits, offers an interesting field in conservative surgery.

In the correction of ectopic ureters, resection of the kidney or part of the kidney supplying such a ureter is without question the operation of choice, provided the circulation permits.

In solitary cyst of the kidney, the question comes up as to whether or not it is better to take a wedge-shaped piece of renal parenchyma with the cyst, and in this way obtain better closure of the wound with less danger of hæmorrhage.

The use of resection in the more unusual conditions of benign tumors and localized hydronephrosis warrants consideration. Whether it should ever be practiced in tuberculosis or malignant disease is a question, but one may feel justified in doing the operation even here, provided the conservation of renal tissue offers a better chance for the patient.

When dealing with the same type of disease, it is usually conceded that nephrectomy carries a higher mortality than resection.

CONCLUSIONS

Resection of the kidney in the dog reduces the weight and phthalein function in all cases and at all times. A return to normal does not occur in a 34 week period, probably never.

Function decreases approximately in proportion to the loss of secreting renal tissue. Even small amounts removed will cause loss of renal weight and function. Scar formation and circulatory disturbances by suture constriction always increase the loss of renal parenchyma.

Resection of small amounts of renal substance does not affect the life or health of the dog and does not cause compensatory hypertrophy of either the resected or the opposite healthy kidney, as evidenced by the weights and functional tests in our experiments.

Both function and parenchyma seem to be present in excess of the animal's healthy needs, since considerable amounts may be removed without evidence of compensatory hypertrophy or disturbance of health.

Complete atrophy and complete loss of function of the resected kidney did not occur in 34 weeks, although there was always some reduction of weight and size—a relative atrophy. Disuse atrophy was never observed.

Renal fistula did not occur and postoperative hæmorrhage was rare.

There is little question that the unfounded fear of hæmorrhage and leakage of urine

following renal resection has had much to do with the unpopularity of this valuable procedure. Leakage did not occur in any of the 37 dogs operated upon and hæmorrhage occurred only once, and in this case it was due to failure to obtain good hæmostasis, because of hurry on the part of the operator, with resultant poor technique. Late hæmorrhage was never encountered.

Since Spiegelberg in 1867, and Spencer Wells in 1884, first resected the human kidney, at least 222 resections have been done for various forms of localized renal pathology (up to 1928). It seems appropriate then to remind the surgeon that after simple renal resection, there may be a loss of function in the resected kidney, dependent upon the amount of parenchyma removed. Considerable renal function will nevertheless have been saved, and may give valuable service to the patient, should he ever require it.

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A USEFUL SEMI-ANÆSTHESIA FROM LUMINAL[1]

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IT will be admitted by many surgeons and surely urged by most patients that both inhalation and local anæsthesia, in current practice, leave something to be desired, hence we have in this series of investigations (a) aimed particularly at the elimination of pre-operative anxiety and strain, (b) endeavored to diminish the amount and concentration of the inhalant used, (c) striven for a period of oblivion coincident with the post-operative suffering, (d) planned for the post-operative patient to drink as usual instead of receiving fluids by vicarious methods—decreased incidence of nausea making this possible.

This report might not have seemed worth while if we had by our plan further complicated inducing anæsthesia, had added anything to the risk involved, or had increased the morbidity inherent to it; our experience seems, fortunately, to have run to the opposite direction.

THE PLAN

For the purpose of this study general anæsthesia is divided into two phases: the first is quite satisfactorily covered by luminal; but the second, beginning with abolition of pain sense, must, to seem safe, be the result of inhalation which, being wholly under our control, can be terminated almost instantly. We do not use a dose of luminal sufficient for deep surgical anæsthesia, because its effects cannot be influenced as circumstances may indicate, nor can the drug be recovered short of its 72 hour elimination period.

This method of employing luminal, which is not intended as a substitute for local or general anæsthesia, greatly facilitates the use of either of them, reduces the amount required, and prolongs the effect of both. (It is a simple matter to secure a luminal surgical anæsthesia, if one so desires, merely by increasing the dose. We gave Mrs. E., November 23, 1929, but 19½ grains then removed an enormous adenomatous thyroid though she received in addition only an infiltration of the skin incision line supplemented by an occasional whiff of gas when extreme traction was required. This amount was for her a relatively large dose.)

Our records show that we have used in selected cases veronal and luminal (alone or in combination with several other sedatives) since March, 1921, as a means of anæsthesia induction in the broadest sense. Rather extended mention of this experience was made in our book entitled *Surgical Treatment of Goitre*.[2] To date we have employed one or the other of these two drugs in about 1,144 operations intended for the relief of an infinite variety of conditions, whereas we at first limited their use to toxic goiter patients. Two groups of these patients will be reviewed forthwith.

SUMMARY I

This study in detail covers 99 cases operated on from May 9, 1929, to August 24, 1929.

Data were gathered under the following headings: (1) thyrotoxic or non-toxic; (2) blood pressure before drug was given; (3) total dose of drug (luminal or veronal) and interval between each dose; (4) blood pressure after drug was given; (5) anæsthetic—(a) general, (b) local, (c) spinal; (6) operation, nature and duration; (7) time of spontaneous awakening after operation; (8) consequences—(a) drowsy, (b) nauseated, (c) headache, (d) dizzy, (e) irrational, (f) restraint used, (g) respiration, (h) pulse.

Toxicity. Of the 99 patients 61 were not thyrotoxic and 38 were toxic.

Dosage. Luminal was given in 40 cases. The usual interval was 3 hours, and 3 grains were given at a time. The total dose varied from 9 to 30 grains; 7 patients had 12 grains or less; 33 had from 15 to 30 grains; but the dose most frequently given was 21 grains (18 cases).

In addition to luminal, morphine or scopolamine, or both, was given to 11 patients before operation.

[2] Bartlett, Surgical Treatment of Goitre, pp. 154–156. St. Louis C. V. Mosby Co., 1926.

[1] From the surgical service of the Missouri Baptist Hospital. Read before the Southern Surgical Association, Atlanta, December 12, 1929.

Veronal was used in 48 cases. The usual interval was 2 hours, and 5 grains was given at a time. The total dose varied from 7.5 to 50 grains. Nineteen patients had 35 grains or less, 29 had 40 to 50 grains but the dose most frequently given was 40 grains (23 cases).

Blood pressure. Readings following the drug effect (before operation) showed the following changes: There was a decrease in 49. The systolic was affected in 8, diastolic in 19, and both phases showed changes in 22 cases: 10 millimeters or less in 13, 10 to 20 millimeters in 5, and 20 millimeters or more in 11 (systolic alone in 8). There was an increase in 23. The systolic was affected in 9, diastolic in 2, and both in 12: 10 millimeters or less in 13, 10 to 20 millimeters in 5, and 20 millimeters or more in 5. No change was noted in 11.

Mixed effects were found in 10 (systolic increased, diastolic decreased in 3, reverse occurred in 7). The changes were not reported in 6.

In only one case was a drop in blood pressure noticeable clinically. This occurred in a chronically depleted, anæmic woman on whom total abdominal hysterectomy of 40 minutes' duration was performed under spinal anæsthesia after 21 grains of luminal had been given. She responded immediately to blood transfusion. The use of barbituric acid derivatives in conjunction with spinal anæsthesia is commented on elsewhere in this paper.

A careful study of the details of blood pressure changes reveals that simultaneous elevation of both phases occurs three times as frequently in thyrotoxic cases as in the non-toxic. Lowered and unaffected readings occur equally in both toxic and non-toxic cases. No variation or a change in either direction of less than 10 millimeters of mercury occurred in half of the cases in this series.

Anæsthesia. Nitrous oxide gas was used in 47 cases; nitrous oxide gas and local infiltration in 34 cases; ether in 8 cases; spinal infiltration in 5 cases; and local infiltration in 3 cases.

Operations. Thyroidectomy was performed in 61 cases (thyrotoxic 38, non-toxic 23); appendectomy in 13 cases; abdominal hysterectomy in 6 cases; cholecystectomy in 4 cases; radical breast amputation in 4 cases; resection of the stomach in 2 cases; and miscellaneous operations in 7 cases. Operation was postponed in 2 cases.

Spontaneous awakening. Awakening occurred in less than 1 hour in 6 cases; in 1 to 4 hours in 17 cases; in 4 to 7 hours in 28 cases; in over 7 hours in 33 cases (luminal 10, veronal 23). The period was undetermined in 15 cases.

Consequences. (a) Drowsiness after operation varied from mild apathy and willingness to lie quietly to deep sleep into which patient would immediately relapse after being wakened. (b) Nausea was present in 33 per cent of all, but 66 per cent of cases having morphine were nauseated. (c) Headache was present in 28 per cent but always yielded to pyramidon. (d) Dizziness was present in 30 per cent of those having luminal. It was not reported as to those having veronal. The dizziness was always mild and transient. (e) Eight per cent of patients were mildly irrational; of these, half had toxic thyroids. (f) Four per cent needed mild restraint. (g) As to pulse and (h) respiration no changes were noted other than those experienced in similar cases of each type prepared by other methods. The respiratory rate in the great majority varied from 18 to 24 after operation.

SUMMARY II

In this series of 65 cases between August 29, 1929, and November 30, 1929, on whom the effects of luminal were studied, the drug was given 3 hours before operation in a single dose. These patients were studied in somewhat different detail from those of the preceding series, with the following results:

Age. The ages varied from 11 to 70 years, largest number being in fourth decade.

Figure. Patients were of medium figure, 67 per cent, stout, 20 per cent, and thin, 13 per cent. In this series the patients were thyrotoxic, 53 per cent, non-toxic, 47 per cent.

Dosage. Nineteen patients received 12 grains luminal, 16 received 15 grains, 13 received 18 grains, and 8 received 21 grains. The remaining 9 patients received from 9 to 30 grains. In addition to luminal 3 patients were given ¼ grain morphine prior to operation.

Effect. Judged on patient's arrival in operating room, the effect was slight in 10 per cent,

moderate in 70 per cent, and profound in 20 per cent.

Operations. Of the 63 operations performed, 2 were postponed after luminal had been given, 35 were thyroidectomies, 20 were on the organs of the abdomen and the female pelvis, 3 were extensive dissections of the neck, and 5 are grouped as miscellaneous.

Anæsthesia. Spinal anæsthesia was induced in 3 cases, local infiltration alone in 1, and 59 inhalation anæsthetics were given, of which 39, or 66 per cent, were nitrous oxide throughout. In 8 more cases, ethylene was given for a few moments only to induce relaxation and the operation carried out thereafter under nitrous oxide. Ether was similarly employed for a few minutes in 2 cases. Ether was not used at all in any other cases. Ethylene alone was given in 8 cases and in 2 cases operations were done under combined nitrous oxide and infiltration. The cases in which nitrous oxide alone was used comprised 74 per cent of the thyroidectomies in this series and 45 per cent of all operations other than thyroidectomy.

The administration of the anæsthetic was described by the anæsthetist as being ordinary in 43 per cent, simplified in 37 per cent, and difficult in 20 per cent. It is to be emphasized that the majority of these patients are "carried," after preliminary induction, at a concentration of 20 to 60 per cent nitrous oxide.

Morphine. We noted in each case the number of hours following operation at which the first dose of morphine was given. Five per cent of the patients received morphine before leaving the operating table; in 9 per cent the first dose was given within 4 hours, in 25 per cent between 4 and 12 hours, in 8 per cent during the second 12 hours, and 53 per cent received no morphine. Those cases in which no morphine was required included 60 per cent of the thyroidectomies (thyrotoxic with one exception) and 47 per cent of all other operations.

The number of doses of morphine (¼ grain in every case but one) given to each patient in the first 12 hours was noted. One dose was given in 21 per cent, 2 doses in 17 per cent, 3 doses were given in 5 per cent (all of whom were on peritonitis treatment), and in 57 per cent no morphine was given.

Duration of effect. One cannot sharply define the time at which the effect of large doses of luminal wears off; there are several effects, in reality, which disappear at different intervals. However, the state which we have in mind as useful to our purpose is characterized by drowsiness of mild or profound degree, lack of interest in the patient's own condition and her attendants, a failure of response to any but sharp, severe pain, and a general willingness to lie quietly in whatever position she is placed. It is true that the reflexes, importantly the cough reflex, are rarely abolished; a patient with much mucus in the respiratory tract will cough it up. Patients swallow fluids quite normally when awakened for that purpose.

Of these 65 cases, the effect as understood lasted less than 4 hours in 6 per cent, between 4 and 8 hours in 10 per cent, between 8 and 12 hours in 15 per cent, between 12 and 24 hours in 36 per cent, and over 24 hours in 33 per cent. The great majority had no recollection of the events during the 24 hours following the luminal, viz., postoperative examinations, change of dressings, visits by relatives, or the arrival of special nurses. Several recalled being transferred from their beds to the cart, but few remembered being prepared in the operating room or the start of inhalation anæsthesia.

Vomiting. Seventy per cent did not vomit during the first 12 hours after operation; 14 per cent vomited once; 7.7 per cent vomited twice; and a similar number 3 times. The remaining patient vomited 7 times.

We employ luminal as routine because (1) we find it entails less nausea and vomiting than does veronal; (2) an immense amount of clinical and experimental data concerning it are at hand; (3) there is not in the literature a single authentic record of death from luminal alone, although at least two individuals are known to have swallowed 50 grains at a dose; (4) veronal, our more favored hypnotic, has an undeservedly evil reputation as a suicide implement, especially among the lay public; (5) veronal has one especial drawback, viz., many patients will fall out of bed following its use unless some form of restraint be enforced (we employed bed "side boards" about 7 inches

high). An occasional patient is sure to be found on the floor if this precaution be neglected.

Our patients are never told that luminal is the drug that has been used, in view of the habit forming potentialities involved. Most patients are aware that barbituric acid compounds are purchasable over the drug store counter, hence the precaution.

Absorption. Experience has convinced us that luminal is not absorbed from the wall of the human stomach (having found it unaltered in the vomitus of patients suffering from pyloric obstruction, after noting absence of hypnotic effect): not enough luminal to be of value was absorbed from the stomach of Mr. McC. (August 8, 1929) on whom resection was done for complete pyloric obstruction. It has no place in stomach surgery if one excepts the rare instances in which pyloric stenosis and retention play no rôle.

In sharp contrast to the result just quoted is the effect of luminal when introduced into the cæcum. It is very similar to that following the usual oral administration. We gained much experience along this line from a 62 year old man, Mr. B. (October, 1929), who wore a water-tight mushroom catheter in a cæcal fistula made for colon drainage and irrigation; he always seemed to react to the given dose in much the same way that one does when it is swallowed.

INDICATIONS

One may be permitted a few random suggestions regarding the particular fields in which luminal semi-anæsthesia seems to be, or not to be, particularly indicated.

Luminal and nitrous oxide gas permit one to perform most of the abdominal operations with utmost facility. Not more than a 15 grain dose has even been required in non-toxic patients (with gas and occasionally a few seconds of ethylene while packing off) for cholecystectomy or for any other procedure down as far as the hysterectomy level. The abdominal wall is not so flaccid as with deep ether or spinal anæsthesia, still, the field exposed is quite adequate for ordinary purposes.

If extreme relaxation is essential to the success of an operation, one does well to employ outright spinal anæsthesia, as for example in co-apting the margins of a large hernial opening, or when compelled to resuture an abdominal wound which has burst open.

A moderate amount of abdominal exploring is quite feasible under luminal and nitrous oxide gas though the patient exhibits more reaction than is the case when spinal anæsthesia is used; still, one can readily palpate a large gall stone through a low incision or locate a pelvic tumor through an opening high in the abdominal wall. It may be added with propriety that modern diagnostic methods have considerably reduced the value or necessity of the one time complete manual exploration with attendant possibility of shock.

The radical breast operation is one in which luminal is particularly of value, for we feel that the field is too high for spinal anæsthesia; nerve blocking is impractical; and infiltration is contra-indicated in cancer. For these reasons, one relied formerly on a deep general anæsthesia in the very patient whose post-operative respiratory excursion was certain to be limited by the character of the work which had been done (pneumonia danger). Very little gas is required if 15 grains of luminal has been taken beforehand.

Luminal preparation would seem to be of especial value on toxic goiter patients who must be carefully protected from every influence calculated to startle, frighten, disturb, or annoy them. While such patients remain utterly oblivious to operating room surroundings, the administration of the nitrous oxide need merely be suspended for a moment and they can be aroused sufficiently during thyroidectomy for the operator to detect the need of an extra ligature, or to establish the presence of any vocal defect which may have been produced by injury to the motor nerve mechanism of the larynx.

The minor anal and rectal operations, which usually require particularly deep anæsthesia, can, strange to say, be done most satisfactorily under luminal and nitrous oxide gas. We have been the more impressed by this fact after our experience in treating secondary ischiorectal abscess in heavy drinkers who had proved to be most refractory ether subjects at the time of primary operations some years earlier.

It may be stated without fear of contradiction that there are two excellent reasons for stressing the use of luminal on patients who are to have local anæsthesia: (1) they naturally are undisturbed after luminal by the psychic elements connected with the injection of novocain; (2) luminal (and all barbituric acid derivatives) are antagonistic in their action to novocain.

We advise caution in the use of luminal as preliminary to spinal analgesia. (1) Such patients come to the table in a condition which renders them somewhat incapable of co-operating, hence a needle may be broken off by a sudden movement of the patient. (2) The flow of spinal fluid is occasionally slowed beyond reasonable limits by lowered blood pressure. (3) The combined lowered blood pressure produced by both methods may be embarrassing temporarily. We were for a time unable to get it at all in one case though the patient recovered after transfusion, as has been stated.

Luminal is not to be administered, of course, in any of those abdominal conditions which contra-indicate fluid by mouth, viz.: peritonitis, ileus, paralytic or mechanical, etc., nor in the treatment of surgical patients who are vomiting from any cause whatever.

DOSAGE

We have used luminal in both sexes, in patients ranging from 11 to 70 years of age and in those of every size, type, and build without having encountered an individual idiosyncrasy in anyone who has taken an amount which experience had shown to be well within safe limits.

One is aided in determining the dose of luminal for an adult by several considerations. Long use of it has shown 15 grains to be the minimum serviceable amount for non-toxic adults. This dose or less will then be given the patient who is (1) of low weight, (2) weak, (3) a good sleeper, (4) very placid, and (5) co-operative. A larger amount should be given the patient who is (1) accustomed to any sedative, (2) who has an increased metabolic rate, (3) is excitable, and (4) who is of very large size. In the extremes of age the dosage will be cut down, of course.

In order to insure the maximum rest, most toxic thyroid patients are given 4 doses (1.5 grains) of luminal per day upon entering our hospital service. During this period we are enabled to detect any unusual sensitiveness to the action of the drug; this is probably the one infallible guide to a correct estimate of individual requirements. If all risk of cumulative intoxication is to be avoided, these doses must be omitted for a period exceeding the 72 hours required for complete elimination before the immediate pre-operative treatment with a rather heavy dose is started.

We have learned *when* it is to be given from our experience with a few patients who have had the operation postponed after the luminal had been taken. It has been noted that they were most soundly asleep at the end of 4 or even 5 hours, hence we shall proceed in future to give the preliminary dose 3 hours before operation; if given earlier than this, too much of the desired postoperative oblivion is lost.

A semi-anæsthetic dose, not exceeding 15 grains, powdered in hot milk, may be given all at one time 3 hours before operation with good effect to a patient whose tolerance is known and who has slept well naturally or has done so on 2 to 3 drachms of paraldehyde, provided the systolic blood pressure is above 100. The advantages of this method are: (1) the effect and more is thus secured on the table and continued longer than did that which followed larger amounts given in broken doses in earlier experiments; (2) the full soporific effect is obtained when most needed; (3) the cumulative risk incident to larger amounts being in the system is avoided during the 72 hours of elimination; (4) the patient is not awakened repeatedly; (5) the nurse is spared the responsibility of judging a patient's need, as was the case when broken doses were given in the earlier series.

While our experience to date (September 19, 1929) indicates that 15 grains of luminal is the minimum routine dose which may be expected to produce an effect that can be described as profound when given to average non-toxic adults, it can by no means be regarded as *alone* producing an anæsthesia in any individual who possesses a normal tolerance for the drug, and it is *not always an adequate* amount

as even preliminary for nitrous oxide anæsthesia on a *toxic* thyroid patient.

The toxic goiter patient, as we long ago learned, rapidly oxidizes every sedative, hypnotic, and anæsthetic drug, hence it is futile and unsatisfactory to expect of her a physiological response to the amount of luminal suited to an individual with normal metabolism. We have given 18 grains if the basal metabolic rate has slightly exceeded +20; 21 grains if it has approximated +35; 24 grains if it has been near +50; and 27 grains if the patient has seemed particularly unruly, though we have occasionally used 30 grains. We do not advise the use of more than 15 grains at one dose under any circumstance. A larger amount should be given in broken doses over a period of 12 to 18 hours while one is on the lookout for toxic symptoms, thus carrying out a tolerance test. But if, after all, the admitted variation in personal tolerance to luminal (as to other hypnotic drugs) leads now and then to underdosage first discovered on the operating table, one compensates with deeper than usual gas anæsthesia; in extreme instances ethylene, or very rarely morphine, is used. Both are useful expedients, but neither is ideal. Still, control of a patient in the operating room presents no problem.

POSTOPERATIVE

Additional barbituric-acid compounds should be used with caution after operation when the need for a postoperative sedative arises, for fear of cumulative toxic action of the drug. When, however, we have grossly underestimated the preparatory dose of luminal calculated to give an uneventful postoperative 24 hours we have occasionally supplemented it with satisfaction as follows: We have given 1.5 grains every 4 hours when patient was awake until marked effect was secured, placing a definite limit of 5 tablets. On September 19, 1929, a toxic goiter patient, had 18 grains before operation, then 9 more in 6 hours, 27 grains in all, with perfect result. We have never considered this practice unreservedly advisable and, of course, the luminal effect cannot be so nearly perfect as when the entire fitting amount is given *before* operation, though it might be large in some cases.

It must be mentioned that our routine practice is to make use of the analgesic effect of pyramidon compound by administering pyramidon 5 grains every 4 hours until 5 doses are given after operation (the patient having been prepared with luminal), in the attempt to avoid use of morphine for postoperative suffering when present (Gasser). We do not claim that actual acute wound pain is satisfactorily influenced by pyramidon, but numerous aches and other evidences of postoperative discomfort can be relieved to the extent that morphine is infrequently required.

Severe postoperative pain is occasionally experienced by patients who have been adequately prepared with luminal. They require small doses of morphine, though in amount and frequency much less than others not so prepared, the effect of morphine being with them deep and lasting. Here again luminal subjects differ but little from patients enjoying normal sleep in that both are awakened by great pain.

As stated, morphine is used by us for actual postoperative pain; but we strongly incline to other measures for the relief of an uncomfortable position, a desire to sleep, headache, aching bones or joints, heat sensations, gas pains, bladder tenesmus, or nervousness. (Morphine given the patient has often done more good for an overworked interne or for a tired out nurse than for the patient who actually received it. This is said without in the least implying bad faith.)

A highly toxic goiter patient should be given ¼ grain morphine just as soon after operation as extreme restlessness begins, no matter how satisfactory the pre-operative effect of a 30 grain dose of luminal has been; it seems better to add this small amount of morphine if needed after thyroidectomy, thus securing almost immediate relief of symptoms rather than to wait for an almost incredibly large additional dose of luminal to take effect.

A singular postoperative paradox is manifest in a few patients after a large dose of luminal, viz., deep hypnosis interrupted every few seconds or minutes by brief periods of excitation, sometimes maniacal in appearance. These sufferers are easily controlled by doses of morphine so small as to be ineffectual in

the absence of luminal. Before giving a second drug we always resort to the restraining sheet, shut out noise and light, while here again employing the soothing touch and voice of a capable nurse. This complication is fortunately rare.

It is to be noted that a small dose of morphine used after operation does not often cause the nausea and vomiting which seem to characterize its use as part of a combined anæsthesia.

INTERRUPTION

The duration of luminal hypnosis is markedly shortened and its intensity correspondingly lessened by an intercurrent surgical operation under gas anæsthesia, although the patient has not been awakened during the entire procedure. This interesting fact is apparent to one who has in a few instances had to postpone an operation after giving the luminal, and then, a few days later, after the same dose had been given had performed the operation. An example follows: after taking 15 grains on October 9, 1929, Miss B. slept 20 hours. Three days later, a cold having cleared up, she was given a like dose and operated on for inguinal hernia 3 hours later. She slept for the succeeding 10 hours, that is, for a total of 13 hours as against the 20 hours during which no operation was done. This instance is fairly typical of several others which have formed a part of our experience.

ADVANTAGES

A surgical anæsthesia produced by luminal and nitrous oxide gas (at times ethylene) has impressed us with certain definite advantages.

1. There are no harmful pre-operative anticipations; the patient is not cognizant of transportation to the operating room; the sights, odors, and sounds which characterize this room fail to register; her condition closely resembles sound normal sleep; still she will sometimes ask a question and will usually answer one; the situation seems ideal from the standpoint of patient and operator alike; the needle prick for local anæsthesia is immediately forgotten while there is little, if any, sense of suffocation accompanying the first inhalation of a general anæsthetic.

2. During the operation a surprisingly small quantity and concentration of gas has been required for complete satisfaction, consequently cyanosis and bleeding are diminished, while hæmostasis assumes a new and unawaited facility.

3. After operation one sees practically no sweating and comparatively rarely any nausea. The postoperative administration of fluids by mouth has in consequence largely supplanted the hypodermic and intravenous methods to the relief of the nurses and to the patient's delight, if she has ever experienced these methods. Her natural tendency to vomiting is lessened, by this luminal method, as stated. (Morphine and the other opium derivatives employed for purpose of *induction* have seemed, in the writers' experience, largely responsible for the vomiting occurring during and following anæsthesias of whatever sort in which they play a rôle.)

There is, too, a welcome postoperative oblivion of many hours' duration (56 hours in one instance). It is unusual for the patient to recall any incident from the day of operation; next day she often fails to recognize the day nurse who returns at 7:00 a.m., to the latter's great surprise—the patient having seemed moderately oriented, though sleepy, when she left at 7:00 the previous evening.

4. An economic phase of the subject becomes apparent when one reflects that a patient who is neither excitable, vomiting, suffering, nor disturbing the neighbors makes a minimum requirement upon the nursing personnel.

We are convinced that luminal alone makes the ideal preparatory drug in doses of 12 to 30 grains, given 3 hours before operation; it is rarely vomited; and no "supplementary" is needed as a rule. The dose, 12 to 30 grains, has harmed no adult, if one excepts a few transient skin rashes, while 30 grains controlled perfectly the wildest toxic thyroid patient imaginable, who had entered the hospital only 10 days before operation, with basal metabolism rate of +122.

We desire to express our appreciation of their suggestions to Professors Gasser and Gruber of the Pharmacology Department, Medical School, Washington University.

CLINICAL SURGERY

FROM THE SURGICAL PEDIATRIC CLINIC, ROYAL UNIVERSITY OF FLORENCE

URANOSTAPHYLORRHAPHY

SENATOR PROFESSOR GEROLAMO GATTI, FLORENCE, ITALY
Director, Institute of Surgical Pathology and Surgical Pediatric Clinic, Royal University of Florence

THE chief difficulties in uranostaphylorrhaphy lie in the production of anæsthesia, the securing of hæmostasis, and the suturing of the edges of the fissure in the palate. The dangers and complications to be avoided are, during the operation, the inspiration of blood from the wound into the respiratory tract which may cause pneumonia, and, during and after the operation, infection of the wound and failure of the sutures to hold.

The indications for the operation depend primarily upon the age of the patient and the size of the fissure.

As to the age of the subject, while it is my custom to operate on simple harelip and fissure of the alveolar border from the eighth month on, I defer operation for fissure of the palate until the patient is 4 years of age, in order to make the operation easier and to avoid complications. A delay until the patient is 4 years of age does no harm, for, as the fissure has a certain tendency to contract, it is then decreased rather than increased in size. I do not defer operation too long, however, for it is easier to correct defects of phonation and pronunciation by education if operation is performed at a relatively early age. Furthermore, the results are better if operation is delayed than if done at the early age of 2 to 4 years or the very early age of less than 2 years. Also when the child is 4 or more years of age it is possible to perform the operation in one stage, particularly as the method I use does not consume a very long time.

As to the size of the fissure, the operation can be performed in all cases in which the fissure is not extremely large and in which the lateral flaps are not so small that there is not enough tissue for a plastic operation; it is only in such cases that it is necessary to wear a prosthesis or make an artificial palate.

Fig. 1. The Junker apparatus with the rubber tube in the patient's nostril. Patient in Rose's position.

PREPARATION FOR OPERATION

The patient is given a purgative or enema and liquid diet the day before the operation. For several days before the operation the nose and mouth are washed with gauze wet with a solution of 2½ per cent potassium chlorate and hydrogen peroxide. At the time of the operation the nose and mouth are thoroughly disinfected with 5 per cent tincture of iodine, the excess being removed after 5 minutes by washing first with 70 per cent alcohol and then with alcohol and ether.

TECHNIQUE

Position of the patient. In order to prevent blood from flowing from the wound into the respiratory tract during the operation, the patient is placed on his back with his head hanging over the edge of the table, that is, in Rose's position, so that the respiratory tract is highest and the vault of the pharynx the most dependent part, thus allowing the blood from the wound to

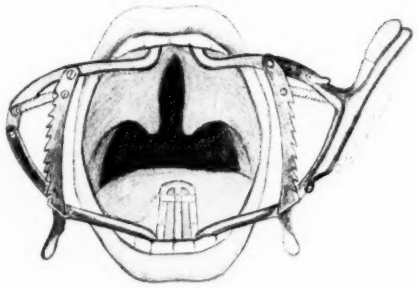

Fig. 2. The Whitehead gag in place.

flow into the vault. With the patient thus and with proper hæmostasis, the anæsthetic may be given without danger of blood flowing into the respiratory tract. The operator sits so that his knees are beneath the hanging head of the patient.

Anæsthesia. The Esmarch's mask covered with sterilized gauze is used to start the anæsthesia. After the patient has been put to sleep I have this mask removed and, in order to continue the anæsthesia during the operation without encroaching on the field of operation, I use a Junker apparatus, the rubber tube being kept in the nostril during the operation. As is usual in early childhood, the amount of chloroform used is reduced to a minimum that is strictly necessary. In later childhood I use ether (Fig. 1).

Keeping the mouth open. One important point is that the mouth be kept wide open during the whole operation. This should be accomplished by some means other than having an assistant hold a gag in the patient's mouth, particularly as the assistant's hands would encumber the field of operation; and also if the patient is not well anæsthetized, the hand gag does not stay in place but moves about allowing the mouth to close, thus interfering with the movements of the operator. I therefore use Whitehead's gag. This keeps the mouth wide open and it is not necessary for an assistant to hold the gag; the field of operation is not encumbered and the spatula of the Whitehead gag keeps the tongue depressed without the aid of an assistant, and the necessity of tongue forceps is eliminated (Fig. 2).

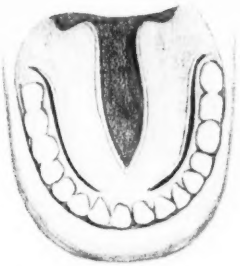

Fig. 4. Liberating incisions.

Hæmostasis. Hæmostasis is accomplished by means of gauze sponges mounted on a sponge-holder with a long handle. This holder is manipulated by an assistant. If it happens that quite a large amount of blood accumulates in the pharynx, a forceps holding a sponge may be introduced into the pharynx one or more times and turned around so as to absorb all the blood and dry the cavity. In my clinic to keep the blood out of the operating field, I also use an aspirating pump which is run by an electric motor.

Freshening of the edges of the wound and detachment of a fibromucous flap from the bone of the palate. The two edges of the fissure in the palate are freshened with a small bistoury. I then make two linear incisions, liberating incisions, near the two alveolar borders and parallel to them; they extend down to the bone and from the canine tooth to the posterior border of the bony palate (Fig. 4).

To detach the fibromucous flap from the bone of the palate I use a "periosteum detacher," with a posterior bend which I devised and had made especially to make this detachment easy and rapid. The periosteum detacher is introduced into the incision and the fibromucous flap is detached from the bone to the fissure, thus creating two flaps which can be moved toward the midline and brought together without tension (Figs. 5 and 6).

Suture of the edges. After these two flaps have been made the edges of the fissure are sutured, the two bridge flaps which have been detached

Fig. 3. Sponge-holder with sponge.

Fig. 5. Periosteum detacher with a posterior angle.

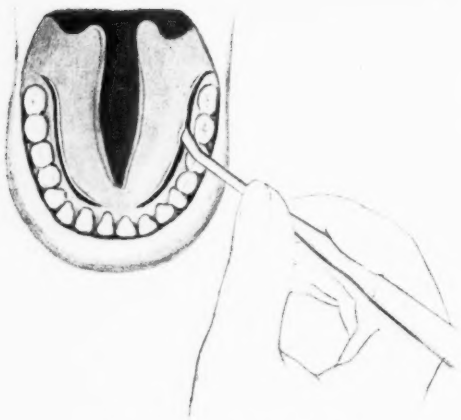

Fig. 6. Periosteum detacher in use.

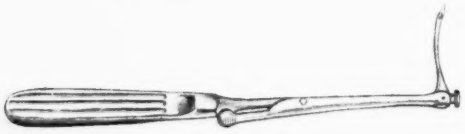

Fig. 7. The Reverdin needle with right-angled holder.

being moved to the midline. As it is hard, even with a small needle with the usual curve, to apply sutures in the small mouth of a child and as it is a slow process because the needle has to be passed through one edge and then removed and reinserted in the needle-holder before passing through the other edge, I use Reverdin's needle with a movable eye attached at right angles to the holder (Figs. 7 and 8).

As this needle has only a slight curve, it can easily be threaded with silk and passed through both edges of the fissure; the silk suture is caught with toothed forceps, the eye of the needle opened, and the needle removed without the thread. The two long ends of the thread are then caught and held with a Péan's forceps. The other sutures are then put in, but are not tied until after they are all in place. Enough tissue must be caught on each side that sutures will hold.

The two liberating incisions along the alveolar borders remain open and are even widened by the two flaps being brought together in the midline, but as the bone lies beneath them that does not make any difference for they soon fill with granulations. The suture line is washed with alcohol and the gag removed.

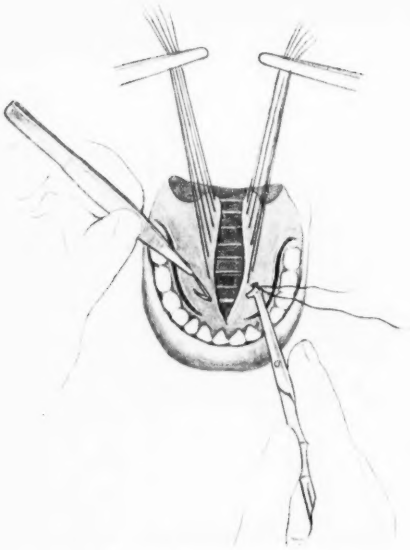

Fig. 8. The Reverdin needle in use.

POSTOPERATIVE TREATMENT

The patient is isolated in a room that is dimly lighted and no one admitted except those who have to take care of him; this is so that he will be as quiet as possible and not talk or eat. For the first 3 days after the operation he is not given any food by mouth. Nutrition and blood pressure are kept up by proctoclysis and rectal nutrient enemas. After 3 days he may be given water and coffee with milk by mouth, through a rubber tube. The mouth is cleaned every day with sponges wet with boric acid solution, and the suture line is bathed with 50 per cent alcohol. The sutures are removed in two stages, the first ones in 10 days and the rest in 12 to 15 days. Soon after this, education in phonation and pronunciation is begun.

RESULTS

With this method the results have been good in all cases; there have been no deaths and the plastic results have been good. As to education in phonetics, phonation, and pronunciation, if this has been carried out diligently over a long period of time, great improvement has resulted in the majority of cases, particularly when the child begins to understand how essential it is that he learn to speak correctly, and he works intelligently himself.

FROM THE LAHEY CLINIC

THE SURGICAL MANAGEMENT OF PHARYNGO-ŒSOPHAGEAL DIVERTICULUM

Based Upon an Operative Experience with Twenty-One Cases[1]

FRANK H. LAHEY, M.D., F.A.C.S., Boston

THE earliest report of a case of œsophageal diverticulum found in the literature was made by Mr. Ludlow, surgeon of Bristol, England, in 1767, in *Medical Observations and Inquiries*, under the title of "A Case of Obstructed Deglutition from a Præternatural Dilatation of, and Bag Formed in, the Pharynx." The specimen recovered at autopsy was prepared and preserved in the Hunterian Museum. During the eighteenth century six further references to similar lesions appeared in the literature, from Italy and Germany. In 1816, in the volume of *Surgical Observations*, Sir Charles Bell published a paper entitled "A Præternatural Bag Formed by the Membrane of the Pharynx." In this article appeared an illustration showing a bag defined in the text as a protrusion of the inner coat of the pharynx through the fasciculi of the constrictor pharyngis. Medical literature throughout the nineteenth century contains a good many references to this subject, but it remained for Zenker and von Ziemssen in *Krankheiten des Oesophagus* in 1877 to clear up the confusion and discussion as to the etiology and symptomatology of the condition. These authors made a careful study of the literature, which included 23 cases previously reported, and added 5 cases of their own, all of which came to autopsy. From the postmortem examinations, they verified the classification of traction and pulsion diverticula, and one of these terms is now commonly used in describing such neoplasms.

Rokitansky in 1840 first correctly described traction diverticula as produced by outside traction on the œsophagus usually from the cicatrix of a previously inflamed lymph node. These diverticula have a characteristic funnel shape. They may occur at any age, even in childhood. They rarely cause symptoms during life because the end of the sac is usually directed upward or horizontally forward rather than downward, and because the muscle layer is usually involved and by its contraction keeps the pouch empty. The site of the traction diverticulum is always in the œsophagus itself, usually on the anterior wall and most commonly at the bifurcation of the trachea.

Pulsion diverticula, on the other hand, have been shown to be of entirely different origin. They are located on the posterolateral wall of the pharynx just above its junction with the œsophagus. They project from between the fibers of the inferior constrictor between the transverse and oblique bundles of the cricopharyngeal division of that muscle. The pouch of the diverticulum is located in the prevertebral space behind and usually to the left of the œsophagus between the layers of the prevertebral and pretracheal fasciæ. The shape of the pouch is sometimes that of the finger of a glove. The small diverticulum tends to be spherical and the

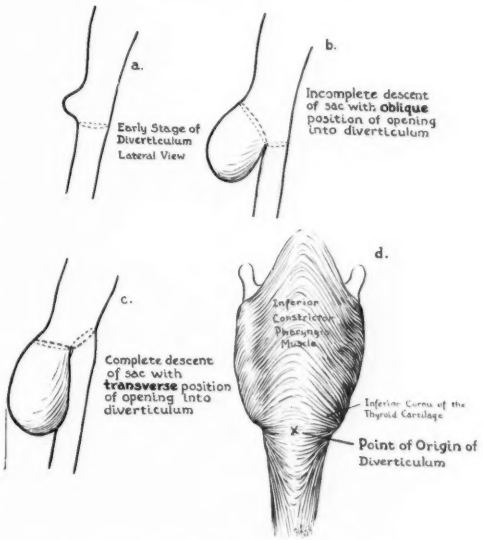
a.
Early Stage of Diverticulum
Lateral View
b.
Incomplete descent of sac with oblique position of opening into diverticulum
c.
Complete descent of sac with transverse position of opening into diverticulum
d.
Inferior Constrictor Pharyngis Muscle
Inferior Cornu of the Thyroid Cartilage
Point of Origin of Diverticulum

Fig. 1. Illustration showing diagrammatically the different stages of diverticula. Early, A; intermediate, B; late, C; and the point on the posterior wall of the pharynx between the fibers of the cricopharyngei muscles through which the sac emerges (pharyngeal dimple), D. This drawing illustrates diagrammatically the relative change in the position of the true opening into the œsophagus and the opening into the diverticulum in the early, A; intermediate, B; and late diverticula, C.

[1] Read before the Southern Surgical Association, Atlanta, Georgia, December 11, 1929.

Fig. 2.

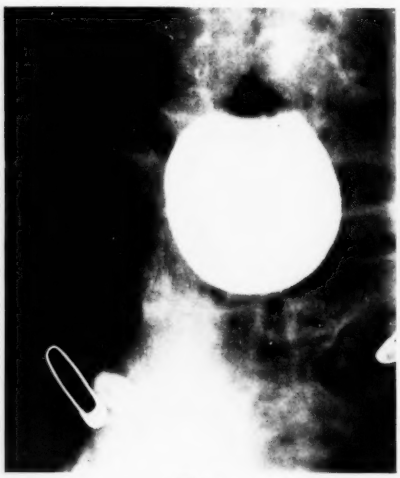

Fig. 3.

Fig. 4.

Fig. 2. Showing the smallest type of œsophageal pulsion diverticulum. This type does not lend itself to two stage operation as described in the text, as it is too small to implant in the wound. In this type, it is better to delay operation until it has increased in size.

Fig. 3. The typical medium sized pharyngeal œsophageal diverticulum. This size will just about implant in the wound with the dome up to, or barely above, the skin level.

Fig. 4. A more or less glove finger shaped pharyngeal œsophageal diverticulum. This type is sufficiently long readily to implant in the wound with the dome well above the skin level. It is the easiest type upon which to perform operation.

Fig. 5. Showing the principle of two stage removal of œsophageal diverticula. The sac has been completely dissected from its bed, in the superior mediastinum when large, or from behind the œsophagus when small, and implanted in the incision in the neck.

Note that, as discussed in the text, the lower angle of the neck of the sac has been completely dissected from the longitudinal œsophagus and also that the sac has been so implanted in the wound that there is no angularity of the œsophagus.

larger ones pear-shaped. The opening into the sac is large in proportion to the size of the pouch.

Œsophageal diverticula are more common in men, the ratio being about four to one. It is a condition of middle or advanced age.

Ludlow believed that the etiology of this condition was traumatic and due in his case to the swallowing of a cherry stone. Sir Charles Bell in 1816 stated that he believed the condition to be due to distention of the pharynx from ineffectual attempts to swallow, thus causing a protrusion of the inner coat of the pharynx through the bundles of the inferior constrictor pharyngis. This theory —that the diverticulum is a protrusion of the mucosa through the musculature of the pharynx due to abnormal intrapharyngeal pressure, plus localized weakness at the so called pharyngeal dimple is still acceptable today. The pharyngeal dimple is the central point in the posterior wall of the pharynx between oblique fibers of the cricopharyngeus where that muscle splits off from the inferior constrictor to become longitudinal (Fig. 1D).

The symptoms of œsophageal diverticulum, as described by Hugo Starck in 1900, are prodromal, direct, and indirect. Prodromal symptoms consist of expectoration of mucus clear or purulent, dryness, and a scratchy feeling in the throat,

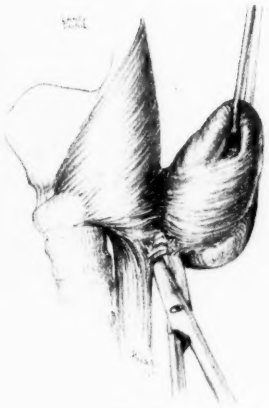

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6. Showing diagrammatically the separation of the adhesions and fibers of the cricopharyngei muscles from the neck of the sac and the longitudinal œsophagus in order to overcome the angulation which occurs here as described in the text.

Fig. 7. Showing diagrammatically the sac pulled to the side upon which the skin incision has been made (left) and the adhesions and fibers of the cricopharyngei on the right between the neck of the sac and the longitudinal œsophagus being separated to make complete delivery of the sac possible.

Fig. 8. Showing diagrammatically the neck of the sac completely freed of its attachments to the longitudinal œsophagus and ready for implantation in the wound. Note the change in angles in the lower and upper points where the diverticulum joins the œsophagus.

salivation, a choking sensation, at times a feeling of a foreign body in the throat, and at times a fear of swallowing because of the feeling that food may stick in the throat. These are the symptoms which are associated with a very small diverticulum, an example of which is shown in Figure 2.

As soon as the sac attains sufficient size (Figs. 3 and 4), direct symptoms appear. These include the inability to swallow large particles of food at first, then smaller particles, then semi-solids, and finally, in the extreme cases, patients are unable to swallow even fluids. The obstruction is due at first to pressure of the sac, filled with food, on the œsophagus to which it lies parallel. The final obstruction is largely due to the fact that the diverticular opening in the œsophagus is so dragged down by traction on the sac that it is no longer lateral, but transverse, and the direct opening into the œsophagus becomes a lateral slit-like orifice. (Fig. 1, a, b, c).

Regurgitation is always present, occurring usually during or after meals. It is frequently spontaneous, but is often accomplished by finger pressure over the sac or by the assumption of certain postures. Regurgitated material is made up of food from a former meal mixed with mucus and may or may not be putrefied. It differs from vomitus in that it contains no hydrochloric acid.

Gurgling noises in the throat frequently appear due to the mixture of air and food within the sac.

Sometimes as a result of the pressure from a large sac distended with foods, hoarseness occurs.

X-ray examination of the sac filled with bismuth shows the diverticulum to be spherical or pear-shaped with a definite, flat fluid level readily demonstrated (Fig. 3).

The treatment of œsophageal pulsion diverticulum other than dilatation, which gives only temporary relief, is surgical, and in an operative experience dealing with 21 of these cases, we have had an opportunity to become acquainted with some of the commonly accepted measures as well as with some of the things which should not be done in operating on these patients.

Mention is made of the number of cases operated upon (1) to prove the relative safety of the operation, and (2) to demonstrate that we have operated upon a sufficient number of these patients to have encountered most of the mistakes and difficulties that may present themselves during operation and to have developed procedures to overcome them. This paper is written with the hope that a discussion of these difficulties and the

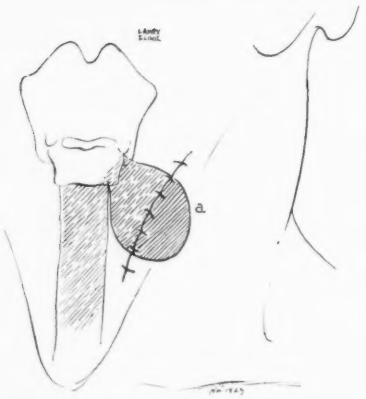

Fig. 9. Showing diagrammatically the acute angulation at point where neck of diverticulum joins the œsophagus inferiorly when sac is not completely dissected and implanted high. Showing also the tendency of food to pass into the sac before its removal, or the sinus after its removal.

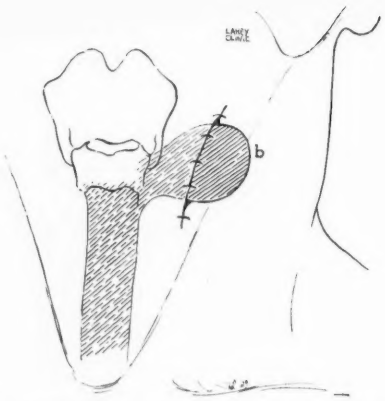

Fig. 10. Showing diagrammatically how complete dissection of the neck of the sac and high implantation overcomes the acute angulation and the tendency of food to enter and accumulate in the sac.

procedures we have developed to overcome them may be of service in preventing others from making similar errors.

The average age incidence in our series is 67. The specific ages are as follows: 42, 43, 46, 46, 48, 49, 52, 54, 55, 55, 59, 60, 60, 61, 62, 68, 70, 70, 72, 76, and 80.

All patients were operated upon by the two stage procedure. In a majority of the cases local anæsthesia was used and today cervical block is used in all cases unless, as occasionally happens, the patient demands a general anæsthetic, in which case ethylene is employed. All patients are swallowing quite well. Two require the occasional passage of olive-tipped œsophageal bougies. There has been no mortality.

As the result of our experience with these cases, we feel that the two stage operation is now so safe and the second stage so easy to do and productive of so little discomfort to the patient, that we have no interest in any one stage plan of removing such diverticula. Based on our experience we feel that should a patient die, after removal of an œsophageal diverticulum in one stage such a fatality would probably not have occurred had the operation been done by the two stage method.

The general plan of the two stage removal of œsophageal diverticula consisting of the complete dissection of the sac and its implantation in the wound as the first step and the removal of the sac at a second stage 10 to 12 days later when the fascial planes in the neck have become occluded, is very well understood (Fig. 3), but experience with the operation has led us to develop procedures which, in our hands, have diminished the immediate complications and have improved the remote results of the operation.

One of the fundamentally essential features of the operation is that an adequate exposure be had of the neck of the sac and also of that portion which descends into the mediastinum. To accomplish this we have made our incisions extend from the level of the cricoid cartilage in front of the sternomastoid muscle well down to the region of the clavicle. In all of our operations we have approached the diverticulum by incisions on the left side of the neck. The incision is deepened until the internal jugular vein is exposed, at which point the middle thyroid veins running from the internal jugular to the thyroid glands are ligated. With these tied, the incision can be deepened to the common carotid artery, behind which is found the inferior thyroid artery, which is caught between clamps, cut, and both ends ligated. We have usually cut the omohyoid muscle at its tendinous portion and have turned the anterior belly forward. This step is not always necessary, although it is our belief that a better exposure of the neck of the sac may be obtained when this is done.

With the inferior thyroid artery cut and ligated, it is now possible to turn the entire lobe of the thyroid gland forward so that the lateral wall of the œsophagus and the side of the diverticulum, when it is small, or its top, when it is large and intrathoracic, is plainly visible.

Fig. 11. Showing a combination of two mistakes which cause postoperative difficulties. Because the neck of the sac has not been completely dissected at its inferior angle, and on its right side, where the diverticulum joins the œsophagus, a high implantation of the sac on the skin has pulled the œsophagus to one side and angulated it. As stated in the text, these two technical errors direct food into the sac, the sac becomes distended, and in some instances necrotic. After the sac has been removed this partition directs food along the sinus and keeps it open. (Compare with Figure 7.)

Fig. 12. Showing the proper position of the sac after the wound had been reopened, the sac implanted at its proper level on the skin, and the œsophagus replaced in its proper median position. Showing also the catheter passed through the diverticulum down the œsophagus into the stomach and sutured by purse string suture into the dome of the diverticulum when immediate feeding is necessary. Note that the proper dissection of the lower angle of the diverticulum and œsophagus is diagrammatically shown.

The sac is grasped with blunt-edged tenaculum forceps of the Babcock type and is gently dissected from its bed behind the œsophagus or in the superior mediastinum.

There are two points here with which, in our early cases, we had difficulty, and concerning which I wish to speak. First, it is most important that all of the adhesions of the sac to the longitudinal wall of the œsophagus (Fig. 6) in back and on the opposite side behind the œsophagus be most carefully and most painstakingly freed. This involves gentle upward traction of the sac, good exposure by means of long bladed retractors placed behind the longitudinal œsophagus, and very careful dissection of all adhesions and cricopharyngeal muscle fibers until the entire sac of the diverticulum rolls out so freely that by traction on the sac the œsophagus can be so rotated that the right side of the neck of the sac can be visualized, demonstrated, and completely freed (Fig. 7). If this step in the operation is not carried out, it will not be possible so to implant the sac in the wound that complete removal of its mucous membrane lining will be possible at the second stage procedure. Incomplete separation of adhesions between the neck of the sac and the right side of the œsophagus prevents adequate and entire delivery of the sac (Fig. 8).

The second point we have learned, and failure to appreciate which resulted in some undesirable complications in our first cases, is that it is necessary so completely to dissect the neck of the sac of the diverticulum up to the point where it joins the œsophagus that its angular relationship with that structure is exactly reversed. In Figure 9 we find that the undisturbed relationship between the neck of the diverticulum and the longitudinal wall of the œsophagus is such that the two walls will be practically parallel, forming between them the sharpest form of an acute angle. Again looking at the same illustration and observing the relationship of the upper wall of the neck of the diverticulum, we find here almost the widest possible form of an obtuse angle. So completely must the dissection of the inferior and lateral walls of the neck and walls of the diverticular sac be made that it can be turned upward so as to cause the inferior acute angle (Fig. 9) to become an obtuse angle (Fig. 10) and the superior obtuse angle (Fig. 9) to become an acute angle (Fig. 10). If care is not taken to make this dissection carefully and completely up to the neck of the sac before the dissected sac is implanted in the wound, swallowed food will still tend to enter the sac because of this undissected partition (Figs. 9 and 11) and, as has twice happened in our experience, the accumulation of food within

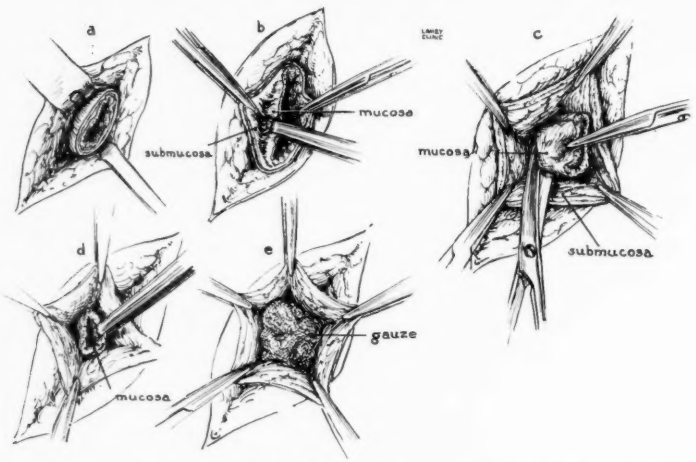

Fig. 13. Showing the wound opened. A, The portion of the sac implanted on the skin cut off; B, the mucosa separating from submucosa; C, the separated mucosa pulled out and being cut away; D, the denuded submucosa free in the wound; E, the remnant of mucosa in the neck of the sac has been freed from the submucosa and pushed down into the wound and the canal made by the denuded submucosa is packed with boric ointment gauze to prevent leakage.

the sac so distends its walls that necrosis of the sac results, requiring its premature opening. A further disadvantage of leaving part of the inferior wall of the sac adherent and undissected from the longitudinal wall of the œsophagus is that such a partition at this point tends to catch food and guide it outward along the operative sinus rather than to direct it downward along its natural and proper course. This results in food being discharged through the side of the neck for a long time after operation, and also closure of the sinus following the removal of the mucous membrane at the second stage procedure is delayed.

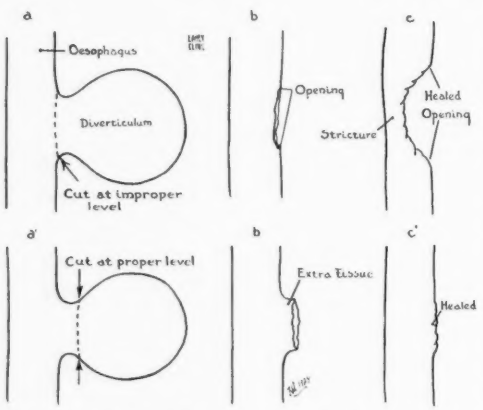

Fig. 14. Showing diagrammatically in A, the improper level down to which the mucosa of the sac is freed and cut off; in B, the type of defect in the lateral wall of the œsophagus which will result from cutting the mucosa off flush with the longitudinal wall of the œsophagus; and in C, a diagrammatically exaggerated narrowing after healing (without suture). A′, represents the proper level at which mucosa should be cut off; B′, the excess of mucosa to prevent narrowing after healing; and C′, healing with the extra cuff and without narrowing.

With the lower angle of the sac completely freed, as described, it becomes possible so to implant the sac in the wound that the body of the sac is a little higher than the neck of the sac, thus maintaining the obtuse angle at the point where the neck of the sac joins the œsophagus inferiorly and preventing food from passing out into the sac and distending it (Figs. 5, 10, 12) as already mentioned. We have described this step in a previous discussion of this subject, and we believe that it is an extremely important point.

One must use care in the implantation of a large diverticular sac into the wound that the sac is not pulled too far out into the wound, thus so angulating the œsophagus that obstruction occurs (Fig. 11). With the wound open and the sac exposed, the implantation must be tested so that a point is found on the wall of the sac to which the skin can be attached without distorting and dis-

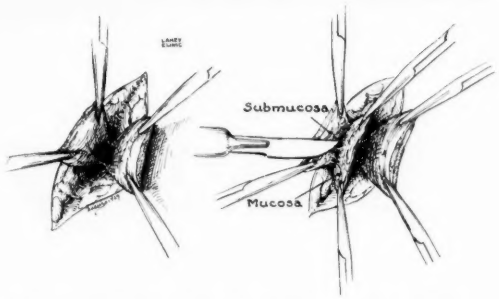

Fig. 15. Showing a method of separating and splitting the entire thickness of the implanted portion of the sac at its upper and lowermost points so that the implanted portion of the sac is converted into two flaps from which the mucosa can then be readily visualized and separated from submucosa down to within half an inch of the longitudinal œsophagus as described in the text. Separation of the mucosa from the submucosa saves difficulties with the internal jugular and common carotid.

locating the œsophagus from its natural median position.

We have in our early experience twice been too anxious to obtain too complete implantations of large sacs upon the skin, with the result that we found our patients unable to swallow even liquids on going back to bed. In these cases we reopened the wounds on the second and third days, replaced the œsophagus in its normal median position, and resutured the sacs in the wounds at proper levels. In both of these cases we opened the apex of the sacs, as they were implanted in the skin after correcting the œsophageal angulation, and inserted catheters down the œsophagus into the stomach in order to be certain that the patients would receive food and fluids. The catheters were held in by purse-string sutures and care was taken to wall off carefully the surrounding skin and wound while the sacs were being opened (Fig. 12).

This is a valuable measure to bear in mind, we believe, and can well be employed in any case in which there is difficulty in swallowing after the first stage operation.

Dissections of the neck of the diverticular sac must be done with great gentleness and care, as, in one's enthusiasm for a complete separation of the two structures, it would be very easy to carry the dissection through the wall of the neck of the diverticulum and thus produce leakage, soiling, and a possible serious cellulitis. We have never had the misfortune to open the sac of an œsophageal diverticulum during its dissection, but we do realize how easily and unknowingly it could be done.

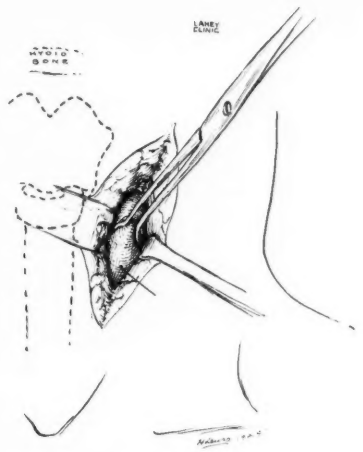

Fig. 16. Showing diagrammatically a sac which has retracted into the wound at the second stage operation. Unfortunately, they are not all as readily demonstrated as this when they have retracted from their skin implantation into the wound.

In our experiences, we have learned that it is easiest to operate on patients with large diverticula. While the removal of large diverticular sacs from the mediastinum is often difficult and demands great technical skill, the size of the sac readily permits of its being so implanted in the wound that the dome of the sac projects well above the level of the skin, and in spite of the shrinkage and retraction of the sac into the wound, which occurs in all cases in the interval between the first and second stages of the operation, the dome of the sac still projects well above the skin level when the second stage of the operation is done, so that second stage procedures under such conditions are extremely simple. The dome of the diverticular sac may be cut off just above the level of the skin. With tacking forceps the mucous membrane lining of the sac may be grasped and by blunt dissection with scissors, because of the œdema and thickening, easily separated from the submucosa with very little bleeding down to the point where the mucous membrane lining the sac joins the mucous membrane lining the longitudinal œsophagus. (Fig. 13, a, b, c, d.)

It is important in removing the mucous membrane that all of it is not removed exactly to the point where the mucous membrane of the diverticular sac joins that of the longitudinal œsophagus (Fig. 14 a). If too much mucous membrane is removed, as will be seen by Figure 14 b,

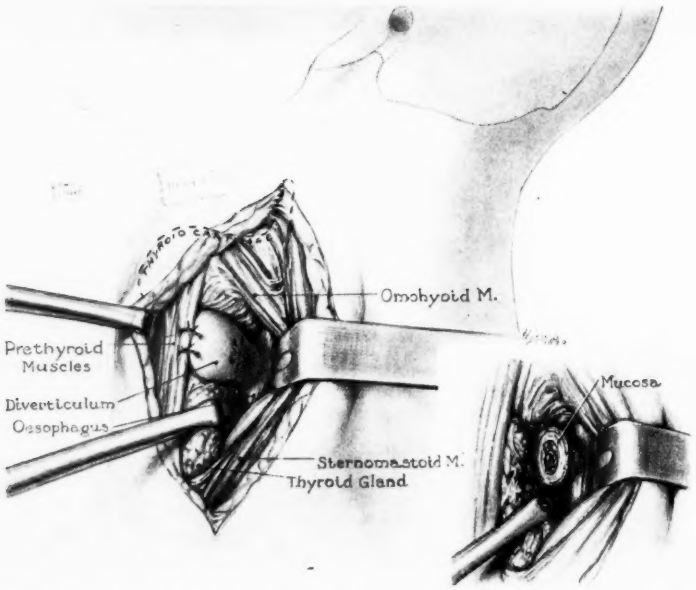

Fig. 17. Showing a diverticular sac, too small to reach the skin, implanted in the wound and anchored at its dome to the outer border of the prethyroid muscles to facilitate its demonstration and re-isolation at the second stage operation. On the neck of the sac, the dotted lines represent the level at which the layers of the sac are cut across at the second stage, and the insert shows this done without disturbing the neck of the sac. In the insert one sees the mucosa and submucosa at the second stage, ready for separation as shown in the next illustration.

closure of the hole in the posterior wall of the œsophagus, which represents the opening into the diverticular sac, can be accomplished only by cicatricial contracture and so (Fig. 14 c) will result in narrowing of the œsophagus.

We had such an experience in some of our cases, and in these patients it is necessary occasionally to pass bougies.

We have suggested and now practice the plan, at the second stage of the operation, of passing the finger down the sac of the diverticulum with its top cut off until the finger-tip just reaches through the opening into the longitudinal canal. With the finger in this position the length of the wall of the diverticular sac can be measured on the examining finger and the finger withdrawn for about a half an inch to allow for a cuff of mucous membrane to be left at the neck of the sac (Fig. 14 a). An amount of the mucous membrane which has been separated down to the neck of the sac and which will correspond with the measured length of the sac wall less one-half inch which has been allowed for a cuff of mucous membrane at the neck of the sac can then be removed (Fig. 14).

If any difficulty is encountered in separating the mucous membrane from its underlying submucosa, the wound can be opened above and below the implanted sac, the entire thickness of the sac readily separated from its implanation in skin, subcutaneous fat, and muscle, and an incision can be made with scissors at the lowest and uppermost portions of the sac through all layers from the level of the skin down to within one-half inch of the neck of the sac. This converts the sac into two flaps as shown in illustration (Fig. 15) and permits of removal of the mucous membrane of all layers of the sac down to the point one-half inch from the œsophagus itself. Preservation of the layer of submucosa and separation of the mucosa from it, particularly on the outer side prevents injury to the internal jugular vein and common carotid artery at the second stage operation.

The first stage removal of small œsophageal diverticular sacs is much easier than the removal of the large intrathoracic ones, but the management of small sacs which do not reach to and remain above the skin level when implanted into

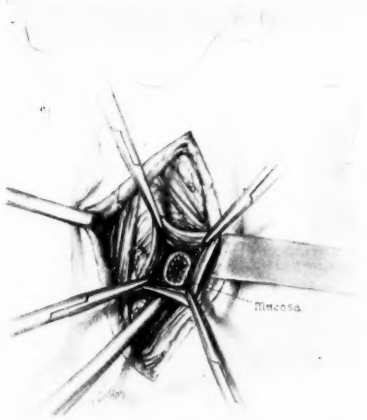

Fig. 18. The submucosa is shown grasped by hæmostats and the mucosa separated and cut off deep in the canal made by the remaining submucosa. This mucosa is shown pushed into the opening in the œsophagus at the neck of the diverticulum in the following diagrammatic illustration (Fig. 19). Note that this makes the dissection of the mucosa from the underlying structures within a canal of submucosa.

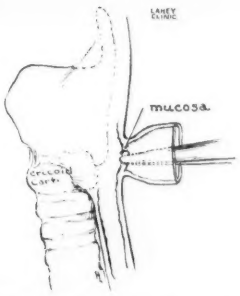

Fig. 19. Showing diagrammatically the mucous membrane dissected from the submucosa, cut off, and pushed down into the diverticular opening into the œsophagus, and the canal of submucosa from which the mucous membrane has been separated, which is to be packed with boric ointment or vaseline gauze.

the wound is not by any means so easy. All sacs which at the time of implantation in the wound, that is at the first stage operation, reach only to or just above the level of the wound, will, as the result of œdema and thickening, retract into the wound below the level of the skin at the end of 10 to 12 days (Fig. 16), when the second stage procedure is contemplated. Many sacs will be found which are so small that they do not reach even to the level of the skin when implanted in the wound.

While large sacs are easy to remove at second stage operations, it is not desirable to delay removal and to subject patients to the constant annoyance caused by the presence of small sacs while they are attaining sufficient size to make it possible to implant them on the skin. Furthermore, it is desirable to remove the sacs of œsophageal diverticula before they have descended deeply into the mediastinum, thus necessitating the opening and exposure of that cavity to the danger of infection. It is likewise quite as desirable to remove small sacs as large sacs by two stage procedures in order to avoid the dangers of cellulitis and mediastinitis.

It must be realized, however, we believe, that there are diverticular sacs so small that they do not lend themselves to two stage procedures (Fig. 2), and one must wait, in such cases, until the sacs have reached such size as to permit of dissection, anchoring in the wound and second stage management.

In small sacs, of the size of the diverticulum shown for example in Figure 3, after the completion of the dissection of the sac, we have anchored the top of the sac to the prethyroid muscles, as shown in Figure 17 making no attempt to bring the sac up to the skin.

The fixation of the neck of the sac to this point makes it easy to find the sac when the wound is reopened at the second stage operation, and likewise prevents the retraction of the sac into the space behind the œsophagus from which it was removed. When the sac is not fixed at this point, due to the fact that all tissues in a reopened wound appear much the same, it is not easy immediately to locate the diverticulum implanted in the wound. With the plan outlined, however, the sac can be very readily found by the easy demonstration of the upper and outer fibers of the sternohyoid muscle to which the sac has been sutured. Care should be taken that the sutures which fix the sac to the muscle do not penetrate all the walls of the sac and produce leakage, but pass only through the outer walls of the sac.

The second stage removal of all of the walls of small diverticular sacs has caused us some uneasiness because of the fact that it is necessary, in the removal of the walls of these small sacs, to reopen into the space behind the œsophagus from which the diverticulum has been removed, necessitating packing this space, and, in our opinion, producing at least a slight danger of cellulitis and mediastinitis. To overcome this danger, we have employed the following scheme.

The small sac is detached at the second stage operation from its attachment to the sternohyoid

muscle, and the top of the sac is cut off with scissors, at the dotted line in Figure 17 and as shown in the insert in Figure 17. This exposes the submucosa of the sac, which can be grasped as in the second stage removals of the large sacs, and the mucous membrane can be separated from the thickened and œdematous wall well down to the point where the sac joins the œsophagus (Fig. 18). The openings in the small sacs are so small that there is no danger, as in the large openings of the large sacs, from narrowing of the œsophagus with cicatrization of the defect in its wall. With the mucous membrane removed from the sac, the excess of sac wall can be cut away, care being taken not to open the cavity behind the œsophagus from which the sac was removed at the first operation, and which is now well walled off by organizing exudate. With the excess of sac wall cut away, a small strip of boric ointment impregnated gauze is passed down into the sac canal, pushing any loose mucous membrane ahead of it into the œsophagus, as the wound is closed about the drain. When the mucous membrane has been freed and pushed into the œsophagus this way (Fig. 19), with boric ointment gauze, there has been but very little secondary leakage of food and fluids following the second stage removal of the sac. This is particularly true if the dissection of the sac has been carefully carried out about the neck of the sac, as described earlier in the paper.

In the beginning of our experience with the two stage removal of œsophageal diverticula, drainage of food and fluids through the side of the neck occurred for a considerable time, often 3, 4, and 5 weeks, but since we have learned to make complete dissections of the neck of the sacs, to separate mucous membrane from the thickened wall of the sac, and in large sacs to implant the sacs in the wound at a slightly higher level than the neck of the sac, we have had no difficulty with prolonged leakage through the wound in the neck and closure has frequently taken place within 10 days.

CONCLUSIONS

The two stage operation for œsophageal diverticulum is a safe one.

Proper dissection of the neck of the sac and high implantation of the sac overcomes many of the postoperative difficulties of the operation.

A plan is presented for the implantation of small diverticula within the wound, and also one for the excision of the mucous membrane lining the small implanted sacs without reopening the space just in front of the prevertebral fascia.

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THE SIGNIFICANCE OF RENAL COUNTERBALANCE IN RENAL SURGERY

With Reference Particularly to the Treatment of Unilateral and Bilateral Hydro-Angular Ureters and Hydronephrosis, with a Description of an Operation for this Condition

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CONSERVATION of renal tissue is the objective of modern renal surgery. Experimental work demonstrates an ability of repair sometimes most remarkable, findings that are being widely confirmed by clinical experience. The growing interest and success in the surgical repair of ureteral and ureteropelvic conditions of obstruction is good evidence of this. The relatively small amount of functioning renal tissue necessary to maintain health is being more and more appreciated, and many patients with advanced renal insufficiency who formerly were pronounced incurable, are now given the benefit of surgery with recovery of sufficiency. One can remove eventually as much as 75 per cent of the total renal mass and the animal will live in good health. In other words, given the equivalent of four kidneys, any one is capable of growth and an increase of activity for all if three are removed separately at sufficient intervals for the gradual optimum stimulation of the remaining portion. The compensation is effected by an hypertrophy of secretory units. Each does more work more continuously than before so that in the end the total work done is the same.

In the enthusiasm of conservation, certain factors that control compensatory hypertrophy are very apt to be overlooked. Of two kidneys, one alone may be injured and the compensatory hypertrophy of the opposite side will be proportional to the extent of the injury. When diffuse or total on one side, the opposite gets maximum stimulation. Often injuries are localized or circumscribed, and then the uninjured units of the injured side

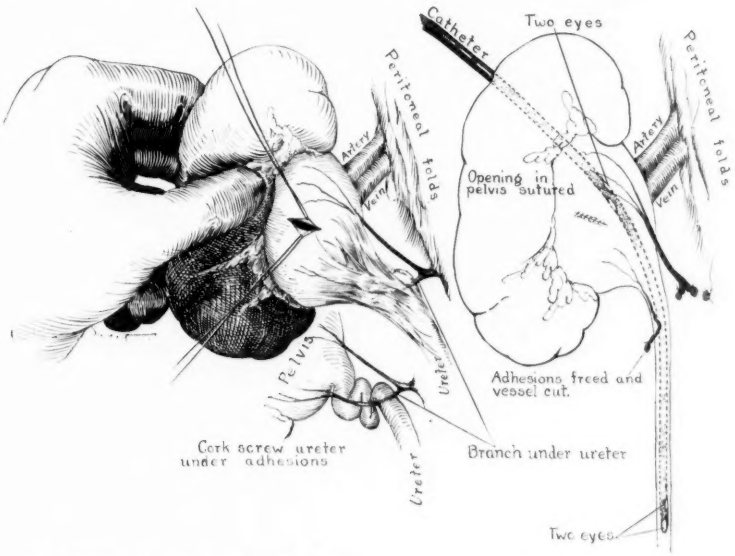

Fig. 1 (D.H., No. 3603). Drawing to illustrate the method of nephrostomy and placing of nephrostomy tube so as to splint the upper ureter after it has been straightened. This case also illustrates the angularity developing above the point of obstruction in the upper ureter, the obstruction being due to a small aberrant vessel. At operation the vessel was divided and the ureter straightened and freed of its adhesions and held in its straight position by a nephrostomy splint as illustrated. Postoperative results excellent.

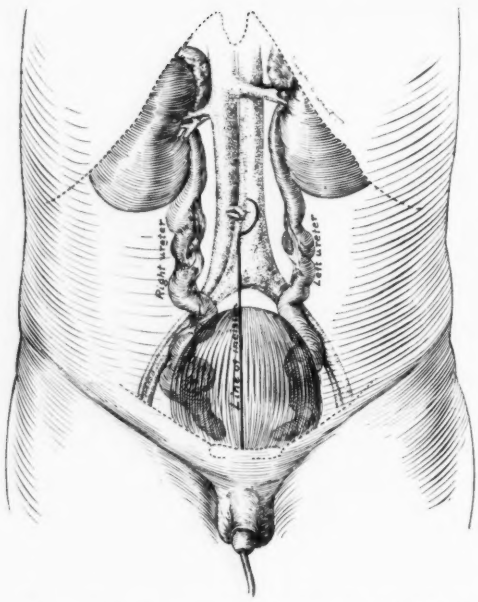

Fig. 2. Diagram to illustrate the line of incision for bilateral exposure of the lower ureters extraperitoneally.

are stimulated equally with the total units of the opposite side the maximum stimulation of which is diminished by their relative ability and number. It is estimated that the human adult has anywhere from 2,000,000 to 7,500,000 renal units (Traut). (Among experimental animals, the dog, 1 million; the cat, 400,000; the rabbit, 250,000; the white rat, 75,000; and the frog, 2,000.) The number varies with the size of the individual, and the greater the number the larger the kidney. If 50 million are removed of a 200 million total, the remaining 150 million will hypertrophy enough to carry on total function. If 100 million are eliminated, the remaining million carry on efficiently (as after nephrectomy), and even when 150 million units are lost, as with bilateral injury, under certain conditions the remaining 50 million will so hypertrophy as to perform the required work. Maximum hypertrophy requires a gradually increasing and constant stimulation. This may be beautifully illustrated by a 30 day period of complete ureteral obstruction in the dog. If the obstruction is removed at the end of this period and the opposite kidney is removed at the same time, the animal dies of renal insufficiency. If the obstruction is removed and the opposite kidney is left undistrubed, there is a minimum degree of repair which is apt in the course of time to be lost and in one to two years a complete atrophy result. But if the 30 day obstruction is removed and the opposite kidney is handicapped by a partial obstruction of its ureter, which leads to its gradual

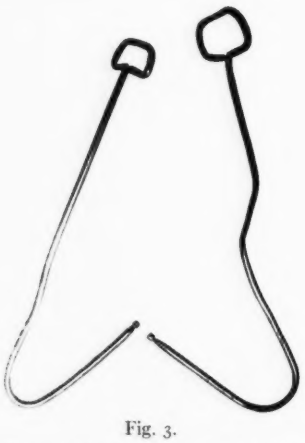

Fig. 3.

Fig. 3. Photograph of nephrostomy probes which are passed retrograde through a small opening in the pelvis in order to find the most satisfactory point for nephrostomy opening in a calyx at the thin portion of the parenchyma. The blunt end is forced through, the capsule cut, and a catheter tied to the grooved end and drawn down through the pelvic opening. The catheter can then be subsequently threaded on down the straightened ureter and the opening in the pelvis closed, as shown in Figure 1.

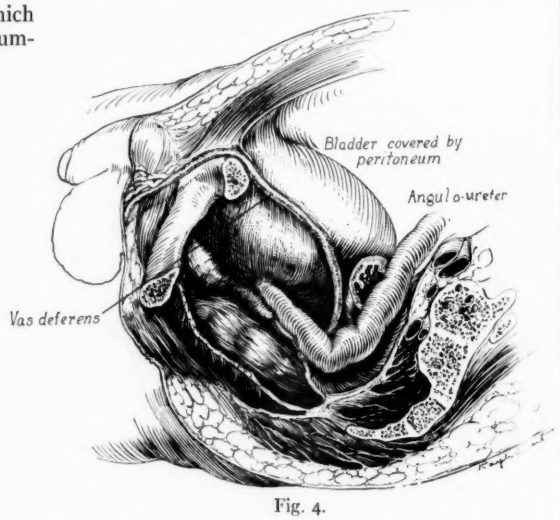

Fig. 4.

Fig. 4. Relation of lower ureter to vas deferens.

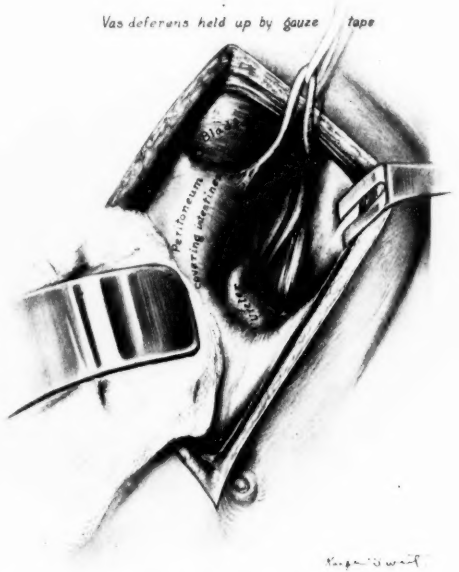

Fig. 5. Extraperitoneal exposure of right side of bladder and ureter.

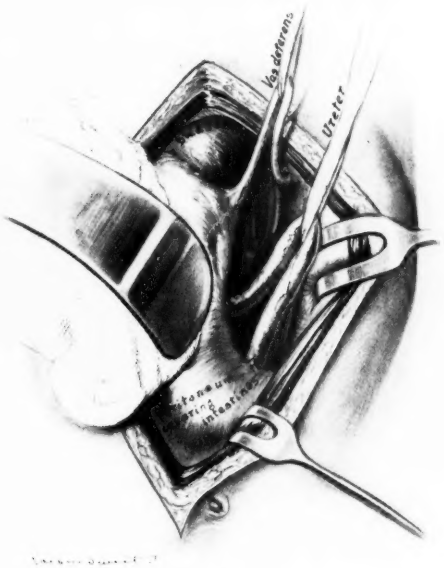

Fig. 6. Angulo-ureter located and freed at pelvic brim or just above.

destruction by complete hydronephrotic atrophy in one to two years, the repair kidney will have undergone, in this time, a maximum degree of hypertrophy easily capable of total renal work. In other words, renal repair is not only proportional to the ability of repair (extent and character of the injury), but to the character and permanency of the demand for repair. The repair in the presence of bilateral injury will be more successful and greater than of the same degree of unilateral injury, provided the injury is of size, because of the greater and more persistent demand. In a slight and early injury, even if bilateral, there will be little difference because either side is still capable of marked hypertrophic changes and, if unilateral, many healthy hypertrophic units still persist in the injured side. But if the injury is marked, bilateral repair will be maximum because it is needed, whereas in a unilateral advanced injury the opposite uninjured side has undergone a certain compensatory hypertrophy which diminishes by so much the need and demand of repair of the injured side.

These statements are all relative to the degree of success of the repair procedure and to the course of the secondary infections almost invariably present. Persistence of pyelonephritis after removal of an ureteral obstruction will handicap and delay hypertrophic changes in that kidney, just as will partial relief of the obstruction by unsuccessful surgery. Ten years ago I did a two stage plastic repair for a bilateral hydronephrosis of size, the total function being 10 per cent. Total function quickly rose to around forty-five per cent, where it has remained, but pyuria persisted with periodic exacerbation and pyrexia. Relative studies have shown a gradual loss of the earlier repair on one side, the last functional test showing only 2 to 3 per cent compared to an earlier 15 per cent. There has been no redevelopment of pelvic dilatation as before operation, but the kidney has wasted away. Two years ago I removed it and it exemplifies an atrophic pyelonephritis. There have been no further exacerbations of infection with pyrexia. The urine has remained clear. Total function remains at forty-five per cent. In an unilateral condition the factors mentioned for and against success are more active. Attempt to repair any infected unilateral hydronephrosis of size is unjustifiable if the opposite side is normal. The chances of success are too small and the degree of repair secured, if successful, insignificant. Unless reasonably sure that at least half a kidney (50 million units) will be saved

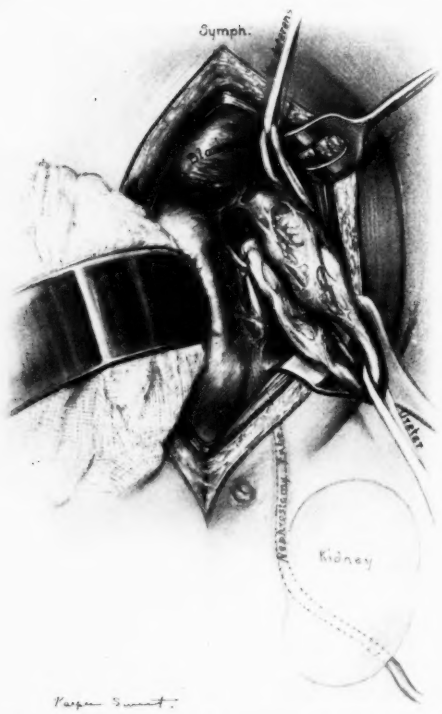

Fig. 7. The angular hydro-ureter has been drawn below the vas deferens. The lower kinks and angularities have not been freed of peri-ureteral adhesions. When so freed, the ureters show very much as in Figure 8.

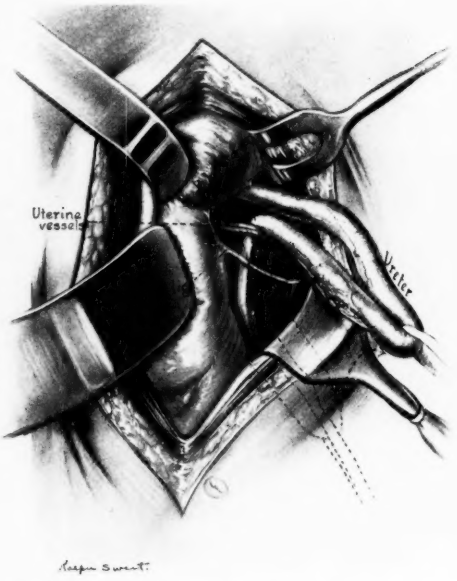

Fig. 8. Ureter loop drawn below uterine vessels. Lower ureter freed and straightened to bladder.

by the conservative surgery, nephrectomy is the procedure of choice. Only half a kidney can be of service in case of subsequent accident to the opposite uninjured side. Less than this can be of no real benefit, and the likelihood of the persistent burden of chronic infection leaves less room for argument. These statements apply to hydronephrosis but not to all conditions. Hydronephrosis is often secondary to lithiasis but the surgical problems of lithiasis, with or without hydronephrosis, are apt to be quite different from those of the more idiopathic type of hydronephrosis. The surgical problems of tuberculosis and renal tumor are specific also. The one rule always applicable is utmost conservation of renal tissue when injury or disease, with exceptions as mentioned, is bilateral. Conservation in bilateral hydronephrosis is in order, but nephrectomy is preferable in every pure unilateral case of size. How this is to be determined is a matter of urological judgment based on careful correlation of the X-ray (size of kidney shadow in relation to pyelectasis as indication of amount of renal parenchyma), of renal function (functional improvement with retention ureteral catheter or after preliminary nephrostomy), and of exploration (check of the aforementioned indications by inspection and palpation at the time of surgery).

A group of cases that illustrate principles of bilateral injury and repair have interested me for many years. They follow lower ureteral and vesical neck obstructions that lead to marked dilatation, elongation, and angularity of the ureters which is usually localized first at the lower third and mid ureter, but when advanced involves the whole ureter. There is, of course, an hydronephrotic atrophy of the renal parenchyma which is usually disproportional to the ureteral change. Large pelvic dilatations, as after obstruction at the ureteropelvic juncture, do not occur, and the ureteral dilatation, elongation, and angularity of the lower portion of the ureter may be quite pronounced before much hydronephrotic atrophy of the renal parenchyma has occurred. Tests of function with catheters in the renal pelves may show an almost normal ability. These hydrangular ureters, however, are definitely obstructive in themselves, and removal of the primary obstructive factor, whether a median bar, posterior

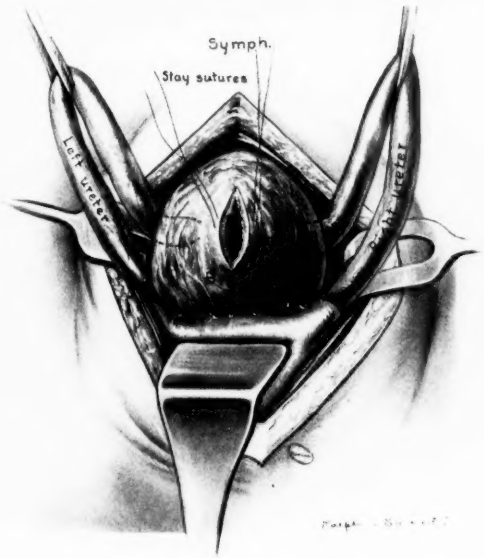

Fig. 9. Bladder opened in midline.

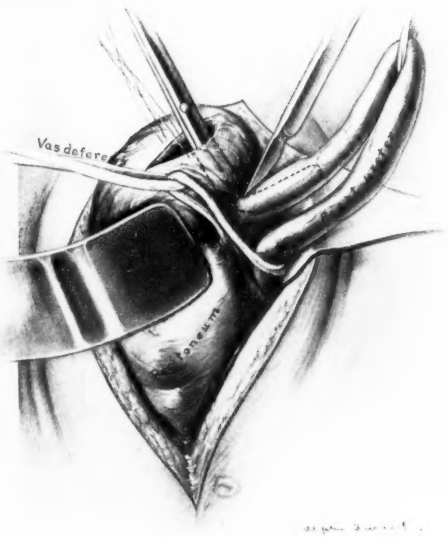

Fig. 11. Incision of ureterovesical juncture on clamp.

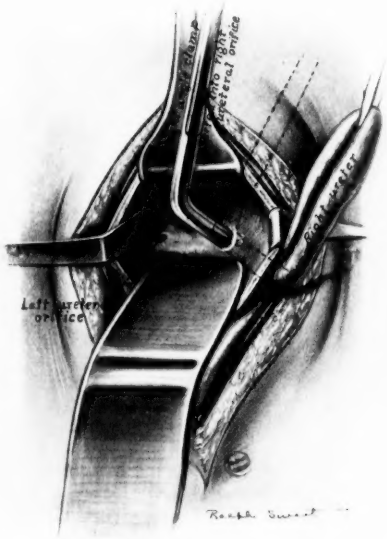

Fig. 10. Right angle clamp passed through bladder into right ureter as tractor and guide for excision of ureter at orifice.

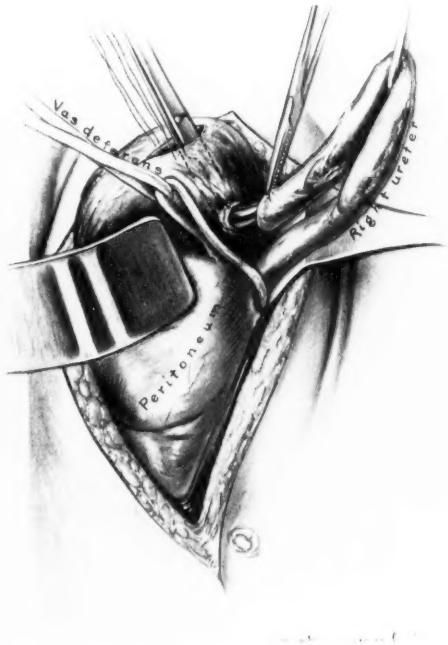

Fig. 12. The cut ends of the ureter are seized in the blades of the clamp and the ureter is excised from the bladder.

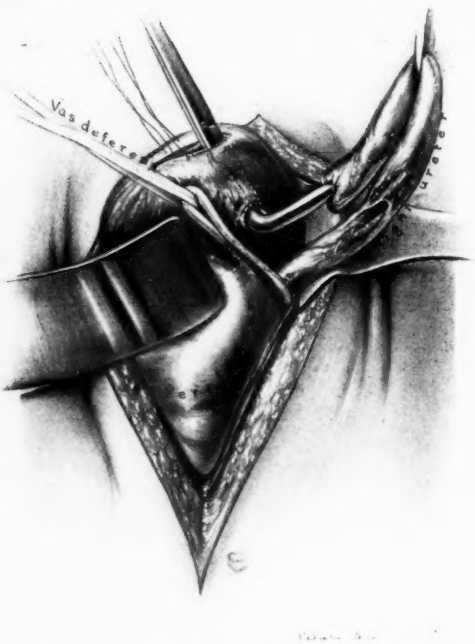

Fig. 13. Ureteral end seized in right angle clamp.

urethral valve, or ureterovesical defect that has led to their formation, may not relieve the kidney from a progressive destruction from back pressure. This fact was demonstrated by a follow up study of a group of patients with posterior urethral valve obstructions with hydrangular ureters and hydronephrosis in whom the obstructing valve had been removed.[1] Subsequent functional studies often showed a gradual loss and pyelography (or cystography where the ureteral orifices are dilated) a progressive hydronephrotic atrophy. A number of these tortuous, dilated ureters have been straightened and shortened surgically, often with surprising benefit functionally, which has shown no falling off even after more than 4 years. This condition is not confined to children. Typical cases occur in adults, the primary obstruction being apparently at the ureterovesical portion, but obviously these patients are only partially relieved by any procedure directed solely at this portion on account of the angular loops of the ureter above, each one of which may act more or less as a valve-like obstruction. The following surgery is indicated in cases of this type when bilateral. If the condition is strictly unilateral, a finding which in our experience is rare (one case), nephrectomy is the surgery of choice for reasons already discussed, except when function of the affected side is 25 per cent (or better) of the total, when partial ureterectomy and cystoneostomy as outlined below may be in order.

The surgery of the condition is of two types according to the degree of ureteral and pelvic change. In advanced cases of the condition usually a two stage type of operation is indicated, whereas in the earlier changes of hydroangular ureters a one stage operation for both sides is all that is necessary.

The first stage of the type of operation of the advanced group consists in unilateral or bilateral nephrostomy, at which time the angular dilated loops of the upper ureter are straightened and a catheter is passed through the nephrostomy opening well down the ureter to splint it (Figs. 1 and 3). Often nephrostomy as a measure of prognosis is

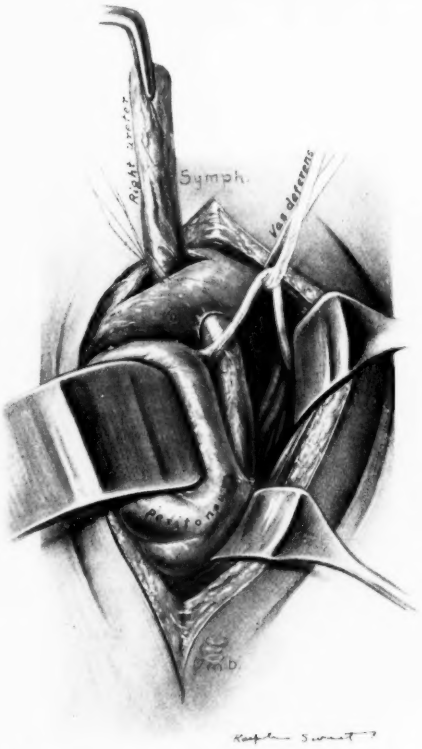

Fig. 14. Ureteral end seized and drawn up through bladder.

[1]Hinman, Frank. Obstructive hydro-ureteral angularity with hydronephrosis in children. Surgical treatment. Arch. Surg., 1929, xviii, 21-58.

necessary in addition to the purpose of removing tortuosities of the upper portion of the ureter that could not be satisfactorily reached from below when the angularities of the remaining portion of the ureter are relieved. Nephrostomy tubes can be left in almost indefinitely if ordinary precautions of irrigation and periodic changing of the tube is attended to. Often the complete lack of functional improvement after such a nephrostomy will clearly indicate the uselessness of any further conservative surgery and the second stage of the operation would be abandoned.

In those less advanced cases in which the upper ureter is fairly straight, the whole repair procedure may be done through a midline suprapubic incision, through which the peritoneum is stripped back from the lateral abdominal wall on either side and the ureters are exposed extraperitoneally (Fig. 2). In the exposure of the ureter for most of its length extraperitoneally, the deep epigastric

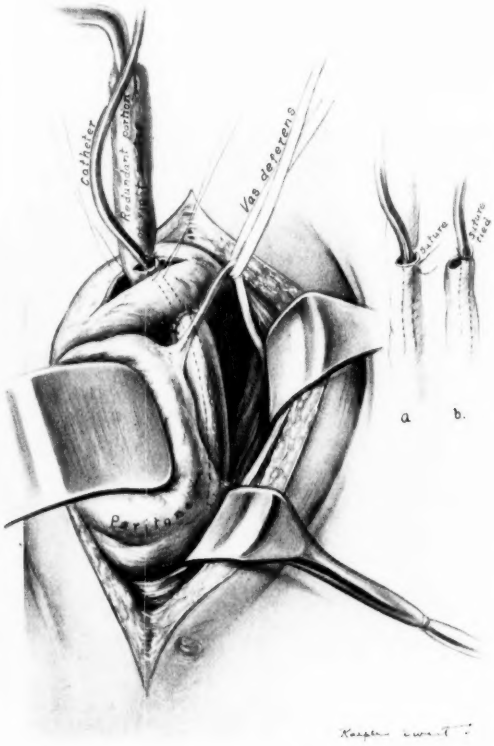

Fig. 15. Interrupted sutures anchoring ureter to external bladder surface.

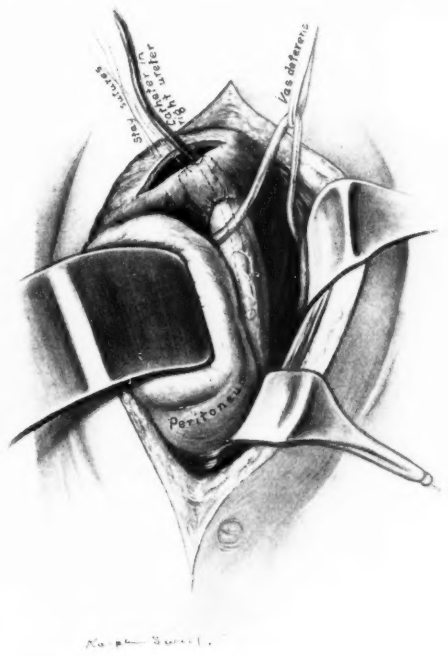

Fig. 16. Interrupted sutures anchoring ureter to external bladder surface and redundant ureter removed.

vessels usually have to be divided and the entrance to the bladder over the vas deferens or uterine vessels must be recognized. The relation to the vas deferens is shown in Figure 4. In stripping laterally, the vas deferens is usually the first to be encountered and a tape is placed under it to localize it, and the peritoneum is then stripped backward, thus exposing the large iliac vessels. Usually the ureter can be seen as it passes over the brim of the pelvis, but often it is more or less adherent to the peritoneum and strips back with it (Fig. 5). When located at the pelvic brim, the ureter is quite readily freed at this point, but may be more or less adherent toward the bladder as well as toward the kidney (Fig. 6). After the ureter has been freed, it is drawn below the vas deferens or uterine vessels, as shown in Figures 7 and 8, and then the bends and tortuosities carefully removed by division of the adhesions and fibrous bands. When straightened, the ureter is found to be very much lengthened, as shown in Figure 9, and it is the next step of the operation to take up this slack and leave the ureter comfortably straight. This is done quite satisfactorily by passing a right angle clamp through the ure-

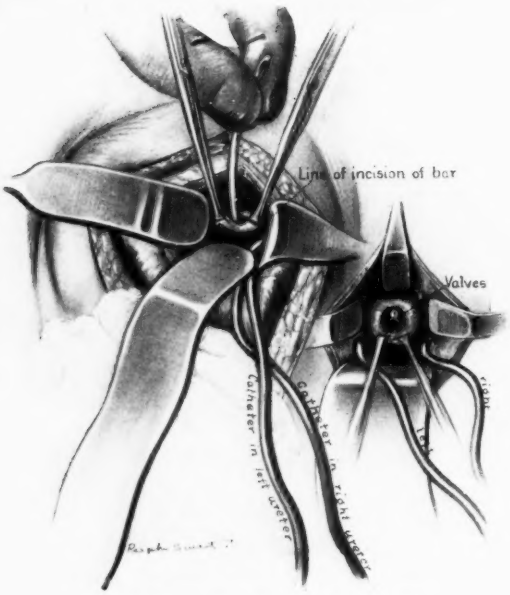

Fig. 17. Removal of bar at neck of bladder.

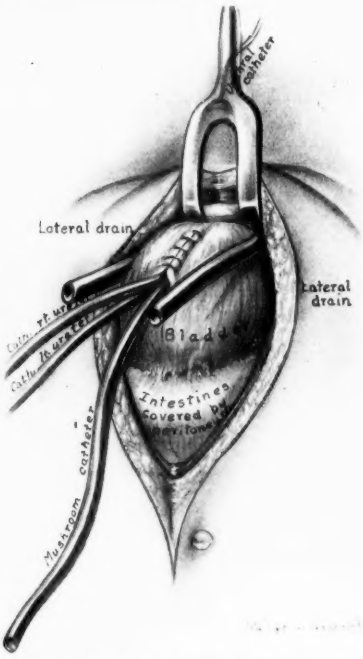

Fig. 18. Drains in place and abdominal incision ready for closure.

teral orifice intravesically, as shown in Figure 10. Where the orifice is small and this cannot be done, the ureter can be opened extravesically and the orifice dilated sufficiently to allow the insertion of this clamp. Such a dilated orifice is required anyway for satisfactory implantation of the hydro-ureter. The bladder is held aside and the ureter then divided at the ureterovesical juncture on the curved clamp, as shown in Figure 11, and the cut ends of the ureter are then seized in the blades of the clamp, as shown in Figures 12 and 13, and the ureter is drawn through into the bladder as shown in Figure 14, until enough of the extra length passes to leave the remainder straight, loose, and satisfactory. The ureter is fastened by interrupted stitches extravesically (Fig. 15) and the redundant portion resected. Usually a considerable portion of the ureteral wall is left projecting into the bladder. A retention catheter is placed through this and sutured to the edge of this intravesical portion. Not too large a catheter is desired, usually a No. 14 to No. 16 and, if the ureter is markedly dilated, it fits quite loosely about this size catheter. In order to allow free drainage into the bladder alongside the catheter and thus prevent any retention sac the ureter is not tied by a circular suture (Fig. 15 a and b). If indicated, the opposite ureter is treated in a similar manner (Fig. 16).

At this stage or previous to the ureteral implantation, at the option of the operator, any obstructive condition remaining at the vesical neck should be radically treated. A median bar or a posterior urethral valve can be quite satisfactorily reached transvesically, as shown in Figure 17. A mushroom catheter, or any suprapubic catheter desired, is placed in, the bladder sewed over this, and the two ureteral catheters for drainage tubes placed in each fossa, and usually a urethral catheter placed for purposes of through-and-through irrigation (Fig. 18).

CARCINOMA AND TUBERCULOSIS OF THE STOMACH

Report of a Case with a Review of the Literature

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THE relative infrequency of tuberculosis of the stomach, as is shown by Broder's review of the literature in 1917, and the rarity with which it occurs in conjunction with carcinoma of the stomach, has made it appear worth while to report this case and at the same time to summarize the cases, 13 in all, reported in the literature.

In 1897, Lowenheim is said to have reported a case of a patient dying of chronic pulmonary tuberculosis in whom a necropsy revealed numerous, typical tubercles in the submucosa of the stomach between the glands of an adenocarcinoma. There were no tubercles in the mucosa. It is not stated whether or not acid fast bacilli were found. The author believes that the tubercle bacilli reached the stomach via the blood stream and that the tuberculosis acted as an irritant and produced the carcinoma. We have been unable to verify this reference. It is, however, cited by Gustav Frank.

Claude, in 1899, reported the case of a man who entered the hospital because of intestinal tuberculosis. There were no clinical symptoms to draw attention to the stomach. At necropsy were found tuberculous lesions of the large intestines, caseous masses at the apices of both lungs, a fatty liver which was slightly jaundiced. Examination of the stomach showed an irregular, rounded tumor near the pylorus which measured 6 by 4½ centimeters. This tumor was pink and was surrounded by a slight ulceration. A short distance from the tumor were several small nodules the size of a pea. Microscopic examination proved the tumor to be definitely malignant. At its periphery were several tubercles, containing caseous material in which acid fast bacilli were demonstrated. The author believes that the tuberculosis was superimposed on the carcinoma.

In 1900, Simmonds reported a case of a man who died at the age of 40 years with intestinal and pulmonary tuberculosis. At necropsy a cancerous nodule, measuring about 2 centimeters (hazelnut size) in diameter, was seen at the pylorus. A short distance from this tumor several small tubercles, about 4 to 6 millimeters in diameter were seen. The author believes that the carcinoma, which resulted in a reduction of hydrochloric acid in the stomach, increased the susceptibility of that organ to tuberculosis.

In making an histological study of 63 stomachs removed at operation for carcinoma, Borrmann, in 1901, was able to find both carcinoma and tuberculosis in two cases. The first of these was a woman, aged 60 years, who had been sick for 3 months. At operation a large, circular carcinoma, composed of cylindrical cells, was found. Microscopic examination showed a large number of typical tubercles with caseous centers in the older parts of the tumor while one small tubercle with one giant cell was seen in the younger part. The second case is that of a man, aged 53 years, who had been sick for 6 months with carcinoma of the stomach. A tubercle, composed of ten giant cells, was seen in the mucosa. This tubercle was completely surrounded by carcinoma. Necropsies, performed on both of these patients, showed no evidence of tuberculosis anywhere else. There is no statement as to whether or not acid fast bacilli were looked for. The author believes both of these to be typical cases of *Futterungstuberkulose* (tuberculosis conveyed by the food). In cases of carcinoma of the stomach he believes that the tubercle bacilli remain in the stomach for a longer time and that the change in acidity gives them a better chance to become implanted.

Borst, in 1902, stated that in one case of pulmonary tuberculosis he saw a large number of tubercles combined with carcinoma of the stomach. No further information was given.

In Barchasch's case (1907) a man, aged 45 years, had been sick from 1½ to 2 years. His condition was diagnosed carcinoma of the stomach. Clinically no evidence of tuberculosis was found. At necropsy a carcinoma of the cardiac orifice of the stomach with metastases to the regional lymph nodes, old pulmonary tuberculosis, and a solitary tubercle in the mucosa near the pylorus of the stomach were found. Acid fast bacilli were demonstrated in this tubercle. The author believes that, in this case, the tuberculosis was superimposed on the carcinoma.

Melchior, in 1913, reported the instance of a man, aged 55 years, who had symptoms of pulmonary tuberculosis for 3 months and was found at necropsy to have tuberculosis of the lungs, pleura, and intestines. The stomach contained a large tuberculous ulcer, which extended from the

cardia to the pylorus. In the region of the pylorus, the stomach was thickened, and the pyloric outlet was partially closed. Sections taken in this region for microscopic study showed an adenocarcinoma.

The case of a man, aged 40 years, who for many years had had a "weak stomach" is reported by Frank in 1913. Eight months before the patient entered the hospital emaciation had become pronounced. On examination a large tumor was found in the epigastrium. The stomach contained no free hydrochloric acid and was dilated. It was found impossible to remove the tumor at operation; a posterior gastro-enterostomy was performed and exitus occurred a short time afterward. Necropsy showed old pulmonary tuberculosis with cavitation, a large ulcerated tumor at the pylorus which partially closed the pyloric orifice, tuberculosis of the lymph nodes around the stomach and in the mesentery. Microscopic examination showed several, small, caseous tubercles, with caseous centers, at the border of the carcinoma. These tubercles were seen in both the muscularis and submucosa. None was found in the mucosa. No acid fast bacilli were encountered, but Frank thinks that this was due to the fact that the tissue had been fixed in formalin. The author believes that, in this case, the tubercle bacilli reached the stomach through the blood stream, as there were no tubercles found in the mucosa of the stomach.

In 1913, Lyle described an instance of a man, aged 40 years, who smoked and drank to excess. Four years before death, he was operated on for fistula *in ano*. He had a "stomach cough" for over a year and a dull pain in the region of the stomach for 5 months before death. Vomiting, which came on 3 or 4 hours after eating, commenced 4 months prior to death and persisted. The vomitus was composed of food taken at the last meal. At operation a large mass was found in the stomach and a partial gastrectomy was performed. The tissue removed was diagnosed carcinoma. In the submucosa there was a coagulation necrosis and several giant cells and epithelial cells. Death occurred 2 months after operation, and at necropsy pulmonary tuberculosis and miliary tuberculosis of the peritoneum were found.

In Anschueltz and Konjetzny's case (1921) no history or details were given. The report only stated that in a case of carcinoma of the stomach caseous tubercles were also found in the stomach.

Hamperl, in 1926, reported an instance of a female, aged 68 years, who complained of pain in the stomach. A large mass was palpated in the region of the pylorus. At operation two-thirds of the stomach was removed. The mass proved to be a carcinoma solidum. Numerous sections were taken and one showed a mass of epithelioid and giant cells.

In 1926, Faltin reported a case of a man, aged 60 years, who had for years suffered from his lungs and stomach. He was admitted to the hospital because of his stomach condition. There were suspicious alterations over the right lung, but acid fast bacilli were never found in his sputum. The stomach was resected and a large, ulcerous, stenosing tumor was found in the neighborhood of the pylorus. Microscopic examination showed tuberculous alteration and a big tuberculous ulceration with adenocarcinoma at the brim. The lymphatic glands along the lesser curvature were also tuberculous. Acid fast bacilli were not found, but the histology showed epithelioid cells, giant cells, and necrosis, so that the author does not doubt that the process was tuberculous in origin. He believes that this case is one of a tuberculous ulcer of the stomach on which the carcinoma had developed.

In our own case, W. M., a Russian Jew, aged 70 years, had been troubled for 4 months with epigastric discomfort after eating. This was occasionally followed by vomiting which had caused him to restrict his diet. About 8 months after the onset of these symptoms, constipation became a dominant feature. Just before admission to the hospital he had a sudden attack of persistent vomiting and a colic-like pain over the abdomen. He was admitted on the Surgical Service of the New Haven Hospital.

On admission to the hospital the temperature was 101.2 degrees F., the pulse rate was 104 per minute and the respirations 42 per minute. An exploratory laparotomy revealed the abdomen to be filled with a cloudy, thick, yellow fluid. The stomach, near the pylorus, was composed of a firm, cancerous tissue and large, firm lymph nodes were felt in the gastrocolic ligament. The whole mass was covered with a fibrinopurulent material. A jejunostomy was made and the abdomen closed. After operation the patient grew gradually weaker and death occurred 23 days after admission.

Necropsy report. The examination was performed 3 hours after death. Only the findings bearing on the subject are included here in detail. The body is emaciated and weighs 35.5 kilograms. The peritoneal cavity does not contain any free fluid. The peritoneal surfaces are dull and opaque. There are numerous fibrous adhesions between loops of intestines, stomach and liver, and liver and diaphragm. Many of the mesenteric lymph nodes contain caseous material. The pylorus of the stomach is contracted so that the lumen measures about 5 millimeters in diameter. Extending from the pylorus for 10 centimeters and almost completely encircling the stomach wall, there is a mass of tissue measuring about 1 to 2 centimeters in thickness. The edges of this mass are heaped up and the center part is depressed. It resembles a healed ulcer. In the middle of this mass there is a perforation measuring about

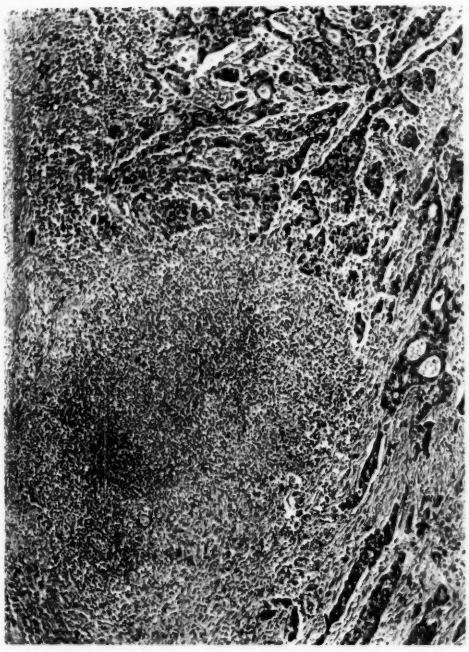

Fig. 1. Microscopic preparation through wall of stomach showing carcinoma and tuberculous necrosis with one giant cell. ×65.

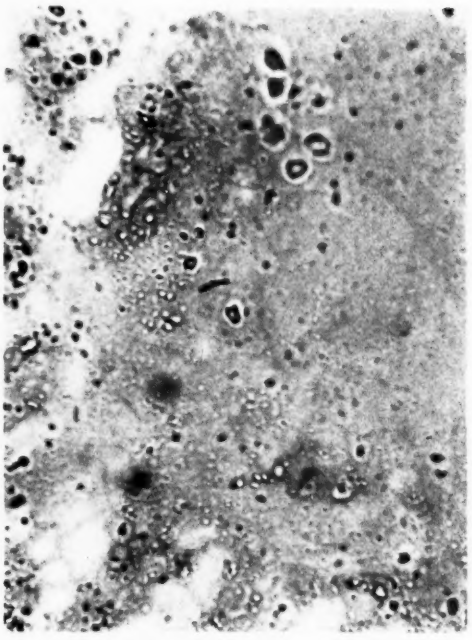

Fig. 2. Microscopic preparation through the same field as shown in Figure 1 near the giant cell showing two acid fast bacilli. ×1200.

5 millimeters in diameter which opens on to the surface of the liver and is surrounded by dense fibrous adhesions. A cross section of the mass is translucent, although there are several opaque dots seen in it. The wall of the remaining portions of the stomach is slightly thickened and the lumen is small. Near the cardiac orifice there is a round mass measuring 2 by 2.5 centimeters which is attached to the stomach by a thin pedicle. A cross section of this mass shows a circumscribed mass of pale, white, translucent tissue, in which several red dots are seen.

Microscopic preparation shows the architecture of the stomach to be completely distorted in the thickened and ulcerated area near the pylorus. The mucosa is replaced by cells which have vesicular nuclei and an occasional mitotic figure. These cells are arranged in a manner which somewhat resembles the normal glands of the mucosa. Between these pseudo-glands there is some fibrous tissue. These cells are heaped up near the edge of the ulcer and extend down through the submucosa into the muscularis. Scattered throughout the tissue numerous mononuclear cells are seen. The serosa is greatly thickened and is composed of fibroblasts, small round cells, and plasma cells. An occasional small mass, of the same type of cell as described in the mucosa, may be seen. A section taken where the stomach and the liver are adherent shows the same picture in the mucosa and submucosa, but in the muscularis and serosa masses of cancer cells are seen next to masses composed of cellular débris. In this area there are several giant cells of the Langerhans type which are surrounded by small round cells and epithelioid cells. Acid fast bacilli are demonstrated in this area. Sections taken through other parts of the stomach show nothing remarkable in the mucosa and submucosa. The outer layer of the muscularis contains several giant cells of the Langerhans type, surrounded by round and epithelioid cells. The serosa is greatly thickened and similar to that described above. A section through the polyp shows it to be completely surrounded by mucosa which shows nothing remarkable. The remainder of the polyp is composed of fibroblasts, among which are seen numerous round cells with vesicular nuclei. This fibrous tissue extends down through the submucosa into the muscularis.

The complete anatomical diagnosis of this case is: Primary: (a) Carcinoma of the stomach with metastasis to regional lymph nodes, diaphragm, mesenteric and colic lymph nodes, pancreas, liver, peritoneum, and splenic capsule with invasion of the splenic tissue; (b) chronic ulcerative and proliferative pulmonary tuberculosis, pleural adhesions, tuberculous lymphadenitis (abdominal and bronchial, tuberculosis of stomach, spleen, liver, and peritoneum. Subsidiary: thrombus in pudendal veins; liomyoma of the stomach.

Of the 14 cases reviewed here, 6 are mentioned in Broder's report, where they are classified either as proved or probable cases of tuberculosis of the stomach. With the exception of Lowenheim's case, a description of which could not be found, we believe that the same classification holds true for the 8 remaining cases, including our own. In

every instance either acid fast bacilli were found or the descriptions, both gross and microscopic, present a typical picture of tuberculosis.

The diagnosis of tuberculosis on a morphological basis alone is, of course, always open to question unless the disease can be reproduced by animal inoculation. In these instances this was never done. In our own case, animal inoculation was attempted but unfortunately the animals died of an intercurrent infection shortly after inoculation. However, we feel that the finding of acid fast bacilli, together with the usual histological picture of tuberculosis makes the diagnosis practically certain. Acid fast bacilli were demonstrated by Barchasch, Claude, and in our own case.

Borrmann, Simmonds, and Barchasch believe that in their cases the hydrochloric acid was decreased by the carcinoma and hence that the tubercle bacilli were not killed but remained in the stomach. Frank, Claude, and Lowenheim think that, since all tubercles are found in the submucosa, the infection reaches the stomach through the blood stream. None of the cases is explained on the basis of infection along the lymphatics. Our own case appears to be one in which the infection spread from the peritoneum into the wall of the stomach by direct extension.

We feel that, with the available data, it is impossible to say what effect the carcinoma or the tuberculosis had in the presence of the other disease. We do not believe, with Borrmann, Simmonds, and Barchasch, however, that the presence of carcinoma favored tuberculosis by retaining the tubercle bacilli for a longer time and under more favorable conditions. Were this the case, one would expect to find tuberculosis in a far greater proportion of the cases of carcinoma of the stomach than actually occurs.

SUMMARY

A case of carcinoma and tuberculosis of the stomach is reported and 13 cases are cited from the literature.

No attempt is made to explain the simultaneous occurrence of the two diseases, as it is felt that as yet insufficient data has been collected on the subject. It is the author's opinion, however, that the theory of Borrmann, Simmonds, and Barchasch as to the effect of the carcinoma on the tuberculosis is untenable.

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CONGENITAL DISLOCATION OF THE HIP

An Operation for Defective Acetabulum

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ANYONE proficient in one of the well tried methods of reduction of congenital dislocation of the hip may obtain a satisfactory reduction in a large percentage of cases if the patients are young and bone development is not deficient. If the dislocation cannot be reduced or if it will not remain reduced because of bone deficiency, something more must be done.

Beside abnormality in the soft parts and changes in the head and neck of the bone in congenital dislocation of the hip, marked changes in the acetabulum were present in 41 per cent of our cases not operated upon. The acetabulum may be deep, covering the head of the femur completely, or shallow and cover it only partly, or not cover it at all. The acetabular roof or shelf may be horizontal, as in normal children, or it may be oblique. When it is oblique but not markedly so, it does not affect the result any more than if it were a normal or horizontal roof. However, when the obliquity is 30 or less degrees from the vertical, the reduction of the hip may be successful but, unless we have been successful in forming an acetabulum which will hold the femur, the head of the femur slowly migrates upward in a few years, and disability follows. In such cases shortening also takes place.

In successfully reduced cases, in which there is a very poor acetabular shelf, assurance against redislocation with the maintenance of normal function can be obtained by implanting a bony shelf above the femoral head.

It must be remembered that certain cases of congenital dislocation of the hip, with an almost vertical acetabulum, may be reduced and remain reduced for 1 or 2 years. After reduction, we have found in some cases that the acetabulum improves in depth and in its overhanging roof, so that nothing further has to be done to secure a permanent and satisfactory result. In other patients less fortunate who have dislocations too old for reduction, a bony shelf may be placed in the ilium above the head of the femur. This will give a bony shoulder to bear the body weight. In such cases, the head of the femur should be brought down as low as possible and placed as far forward in an anterior position as possible before the bony shelf is made, because (1) there is less abnormal tilt in the pelvis when the head of the femur is anterior, and (2) the ilium is thicker anteriorly and therefore provides a better and a more substantial base for the implantation of a shelf.

The operation of making a bony shelf in such cases has been done for many years. Recently, however, the importance and value of the method have been realized more than ever and efforts are being made to perfect the technique so that the operation will be more generally used.

Probably the first operation of this type was done by Koenig in 1893, later it was done by Ridlon and Ferguson (1904), Jackson Clarke of London in 1909, Albee in 1913, and Ellis Jones in 1920. Later, it was used by N. Fairbank of London, Lambeau, Vance, Delageniere, Mauclaire, Dujarier, Hallopeau, Spitzy, Dixon, Allison, Swett, Wallace, Ober, Bruce Gill, etc.

The bony shelf has been proved by many to be of great advantage in both young and old; it relieves pain and fatigue, helps to improve locomotion, and maintains the length of the leg.

The principal feature of the operation is the turning down of part of the ilium above the head of the femur, and the placing of a tibial graft above in the space where the ilium is bent down. In one instance, Hallopeau used dead bone as a graft. Spitzy placed a tibial graft in the head and

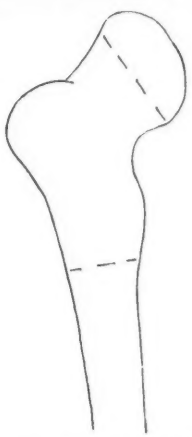

Fig. 1. Dotted line represents the limits of the graft removed from the neck, trochanter, and shaft of the femur.

Fig. 2. X-ray shows the graft implanted in the ilium and the outer table of the ilium slanted out and resting against it. (Notice thickness of the graft which is driven through a slot in both tables of the ilium.)

neck of the femur and made it transfix the ilium, and also placed above this a tibial graft.

The writer wishes to describe a procedure which is satisfactory, simple, and rapid and which embraces the principles of the methods mentioned but which involves less operative work, in that only one incision is required for the exposure of the operative site and the procuring of the graft. The graft obtained is thick and stands out from the ilium. It is broad in that it covers the head of the femur, and it is big enough to be driven solidly into the ilium and still stand out well. It is in contact with bone at its outer margin thus insuring long life. A triangular space is shut in by three surfaces of bone, which is filled in later by solid bone (Fig. 3).

OPERATION

An incision is made from the anterior superior spine of the ilium to 2 centimeters below the top of the trochanter and then backward and upward. The soft parts are reflected upward, thus exposing

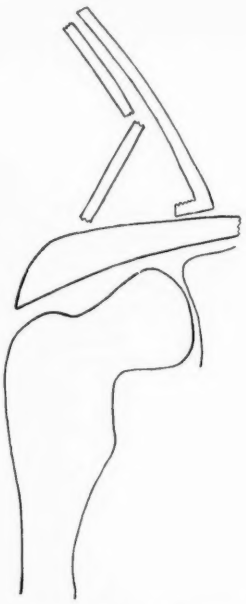

Fig. 3. Outline of the graft in position driven into the slot above the acetabulum with the bone chiseled from the outer table of the ilium resting above against the ilium and below against the graft. At this point it is sutured to the graft which is firmly imbedded in the ilium.

the capsule of the joint; a slot is made through the outer and inner table of the ilium (Fig. 3), just above the head of the femur and extending some distance posteriorly and anteriorly. This slot is cut with an osteotome and is made sufficiently broad and long to hold a good size piece of bone. A square is cut from the outer table of the ilium above this (Fig. 3) and separated from the ilium at its lower edge and at its sides, while the upper edge remains in contact with the ilium (Fig. 3).

A graft is taken from a portion of the trochanter and the adjoining neck and shaft of the femur (Fig. 1) posteriorly (or anteriorly) and cut thick and large enough to cover a wide space above the head of the femur. This method of securing the graft simplifies the operation and eliminates the necessity of making a separate incision to obtain the graft. The graft is driven into the ilium. The square piece of bone, which was cut from the outer table of the ilium above the acetabulum is lowered and remains in contact with the ilium at its upper edge. Its lower edge is fastened to the outer edge of the femoral graft with one catgut suture. The soft tissues hold this

in place as they are firmly sutured over it. Its upper edge may be shortened in the middle, making this piece of bone longer at the sides than in the middle. These longer sides can be fitted into slots in the ilium, if necessary.

This method is also applicable in cases in which the head of the femur is high on the ilium and not reduced. In this type of case it is not possible to make a socket as the bone is thin, and a substantial piece of bone cannot be turned down. A shelf of bone, however, can be implanted into any part of the ilium. I have also used a graft from the crest and adjoining ilium, removing a quadrilateral piece subperiosteally. This is not as heavy as a trochanteric graft and requires a separate incision. A large amount of bone is later deposited between these surfaces of bone and the outer edge of the graft away from the ilium will have bony contact, thus making it more permanent. A curved acetabular roof may be necessary in certain cases. In this operation, it is almost straight. A graft of substantial size is sufficient, provided it is well placed and provided it extends out broadly either side of the head of the femur.

I recommend this way of implanting a shelf and of obtaining a very substantial graft from the neck, trochanter, and shaft of the femur with a sloping piece of bone from the outer table of the ilium, which stabilizes the shelf and thereby makes bony contact at its outer edge.

In over 3 years, I have used the operation in 9 cases and while the patients have been substantially benefited, it is too soon to judge the ultimate results. The ages of the patients varied from 6 to 18 years.

The operation is done to secure a good bony shelf, and thus improve weight bearing, decrease fatigue, and improve locomotion. It may be used if the ilium is not thick; in fact, the method has proved as successful as did the method of turning down the ilium and placing the tibial graft above the acetabulum. At the same time we secure a thicker and larger shelf and the operation is easier to perform as it requires but one operative field. Another advantage is that it can be done rapidly.

I would emphasize again that we can secure a satisfactory graft either from the anterior or posterior portion of the surface of the trochanter and neck and shaft of the femur. The graft may be made of very satisfactory shape; it may be cut broad, long, and thick. When it is driven into the ilium solidly above the head of the femur, it is firmly implanted and will not easily be displaced. It may be re-enforced by the piece of bone cut from the outer table of the ilium (Fig. 3). This is not necessary but gives added strength.

Something must be done to maintain reduction in those cases that have defective bone formation at the time of operation and something must be done to improve function in those cases that cannot be reduced. This operation will give a good shelf in both types of cases and is a comparatively simple procedure and has proved satisfactory.

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MECHANICAL AND ANATOMICAL PRINCIPLES OF OPERATIONS FOR DROP FOOT

Suggested New Operations[1]

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THE ankle joint is a complicated hinge-joint composed of the talus, inferior end of the tibia, and the respective malleoli of the tibia and fibula. Articulating cartilage covers the contiguous surfaces.

The convex surface of the talus is broader in front than behind and is approximately twice the length of the concave surface of the tibia. Grooves or notches appear on the neck and posterior end where the talus impinges with the respective margins of the tibia when the foot is fully dorsiflexed or plantar flexed. Occupation and habits determine the size, depth, and structure of the impinging surfaces. Distinct articulating facets are occasionally discovered. "Squatting facets" (Morris) have been reported on the bones of ancients and orientales.

ANKLE JOINT MECHANICS

Although the motion occurring between the concave tibia and convex talus resembles a hinge-joint, the actual transverse axis passes through the tips of the malleoli and body of the talus considerably below its articulating surface.

This hinge motion has been variously estimated ranging from 45 to 60 degrees of dorsiflexion to 115 to 125 degrees of plantar flexion. The ankle mortise permits very slight forward motion of the tibia on the talus, but negligible lateral motion.

Dorsiflexion is normally limited posteriorly by (1) the plantar flexor muscles and (2) the talotibial and talofibular ligaments; anteriorly by impingement between the neck of the talus and the anterior margin of the tibia; mesially by posterior part of the deltoid ligament; and laterally by the calcaneofibular ligament.

Plantar flexion is normally limited anteriorly by (1) the dorsiflexor muscles, (2) the talotibial ligaments, (3) the tibionavicular ligaments, and (4) the talofibular ligament; posteriorly by impingement of the posterior groove of the talus and the margin of the tibia; internally by the anterior part of the deltoid ligament.

Forward motion of the tibia on the talus is prevented by (1) interlocking of the convex talus and concave tibia, (2) wedging of the ankle mortise on the increasing width of the body of the talus, and (3) anteriorly by the talotibial, tibionavicular, and the talofibular ligaments.

Lateral motion is prevented mesially by (1) the internal malleolus, (2) by the deltoid ligaments and its components, the talotibial, calcaneotibial,

[1]This treatise is based upon studies made in the Laboratory of Anatomy at the Graduate Medical School of the University of Pennsylvania.

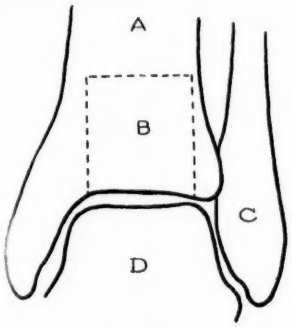


Fig. 1.

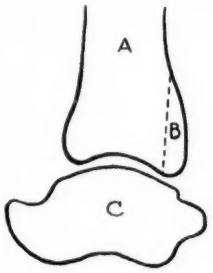


Fig. 2.

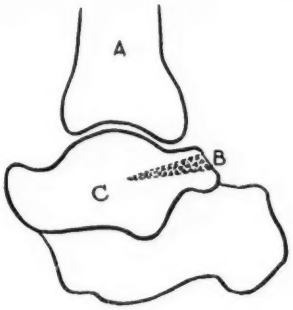


Fig. 3.

Fig. 1. *A*, Posterior view of tibia; *B*, outline of bone graft; *C*, posterior view of fibula; and *D*, talus.

Fig. 2. *A*, Side view of tibia; *B*, side view of graft showing its wedge-shaped appearance; and *C*, talus.

Fig. 3. *A*, Side view of tibia; *B*, bone chips wedged into the osteotomy of the talus; and *C*, talus.

and the tibionavicular ligament; and laterally by (1) the external malleolus and (2) the calcaneofibular and the talofibular ligaments.

MECHANICS OF DROP FOOT DEFORMITY

Paralysis of the dorsiflexors permits the unbalanced plantar flexors, assisted by gravity, to draw the foot plantarward into the drop foot position. The paralyzed structures stretch and relax while the plantar flexors contract and shorten. The extreme limit of plantar flexion is registered when impingement occurs between the posterior groove of the talus and the margin of the tibia.

There may be an additional dropping of the forefoot called "metatarso-equinus," which takes place at the mid-tarsal junction and is confused with typical drop foot.

Literature and statistics are not available regarding the erosion or pressure atrophy that occurs at the points of contact on the talus and tibia after years of service. Since these structures are normally endowed with bone checking properties, it is entirely reasonable to assume the existence of a maximum resistance to atrophy.

IDEAL BONE CHECKING MECHANISM

These normally impinging surfaces, by virtue of their mechanical structure and strategic location, make an ideal bone mechanism for resisting or checking plantar flexion. Although, apparently ideal in arrangement, this anatomical bone blocking device is not utilized by the popular surgical procedures for the correction of drop foot deformity.

The present cadaver studies were undertaken with the object of developing a surgical technique utilizing this anatomical mechanism.

REVIEW OF BONE BLOCK LITERATURE

Several bone block operations for drop foot have been described. Only one, however, could be found depending entirely upon this anatomical device.

C. Lambrinudi records an operation, in which he reconstructs the head and neck of the talus and transposes the fragments for a wedge under the posterior end so that the talus is almost vertical. The normally impinging surfaces of the talus and tibia thus prevent plantar flexion. Mechanically it fulfills our ideal bone checking requirements. He reports 9 operations with 2 technical failures.

Our cadaver studies verified his mechanical conclusions, but also demonstrated the operation to be technically difficult as a laboratory procedure.

Campbell employs a bone blocking device constructed of new bone and does not entirely utilize the anatomical mechanism. Both of his operations require the removal of the posterior end of the talus. His first procedure (1) replaces the end of the talus with a pillar of bone obtained from an associated tarsal arthrodesis. This newly constructed bone impinges with the posterior surface of the tibia. Campbell's second operation (2) replaces the posterior end of the talus with a bone pillar made by turning up successive shavings from the upper surface of the calcaneus. This new bone also impinges with the posterior surface of the tibia.

Both of Campbell's operations are popular and apparently successful. The technique on the cadaver is simple but impresses one with its possible frailty. Several fractures of the new bone pillars have been reported and pressure atrophy is a probability.

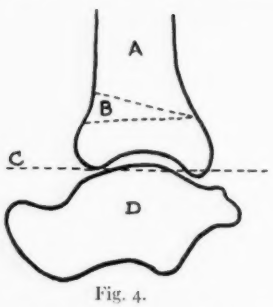
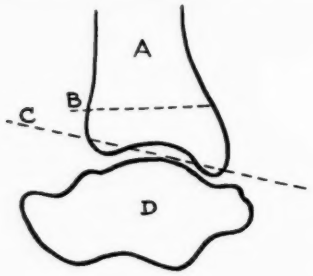


Fig. 4.



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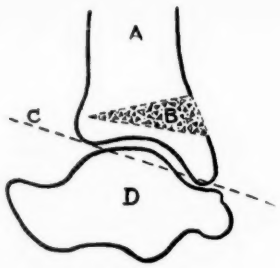

Fig. 6.

Fig. 4. *A*, Side view of tibia; *B*, outline of wedge-shaped osteotomy; *C*, plane of ankle joint; and *D*, talus.

Fig. 5. *A*, Side view of tibia; *B*, line of old osteotomy; *C*, plane of ankle joint; and *D*, talus.

Fig. 6. *A*, Side view of tibia; *B*, linear osteotomy wedged open; *C*, plane of ankle joint; and *D*, talus.

SUGGESTED BONE CHECKING OPERATIONS

The bone checking operations here described, we believe are unpublished and clinically untried. They are presented only as surgical laboratory procedures. It is possible that they may have clinical application in selected cases. Although bone blocking operations are alone seldom sufficient and are usually associated with appropriate combinations of arthrodeses and tenoplasties, these associated procedures will not be discussed.

Except for the anterior wedge-shaped osteotomy, later to be described, the operative approach is by the usual Z-shaped division of the Achilles tendon and need not be presented in detail. This approach will permit free exposure of the lower posterior 2 or 3 inches of the tibia, ankle joint, and the talocalcaneal joint.

Sliding tibial graft. Upon the posterior surface of the tibia, schematically represented in Figure 1, outline the area of the graft, which should be about the full width of the ankle mortise and extend up the shaft about 1½ inches. With a circular saw or preferably an osteotome cut to a depth of about ½ or ¼ inch. Mobilize the graft from above downward by means of a wide beveled chisel. Begin as though it were to be an osteoperiosteal graft and increase the depth as the joint is approached, as shown in Figure 2. The one essential thing is to include within the graft the impinging joint margin of the tibia. Slide it down until the graft engages with the posterior end of the talus when the foot is held at a right angle. If the graft is the full width of the ankle mortise the two distal corners, enter the insertion of the capsular ligaments on the tibia, and provide sufficient tissue for suture attachment. The graft may be anchored by metal or bone screws, sutured to the sides of its bed through drill holes, or, better still, sutured to the capsular ligaments.

Should the graft alone seem insufficient it can easily be re-enforced by bone chips taken from the tibia or from an associated arthrodesis.

Since all cadavers in our series were of adults it was quite impossible to determine the full effects of the operation on the epiphysis. It is significant, however, that of the 213 cases reported by Campbell (3) more than half were in adults in whom the epiphysis would not be involved. The operation is not itself an emergency measure and might easily be delayed to a period of election.

Osteotomy of the talus. Fully expose the posterior structures of the ankle and arthrodese the talocalcaneal joint from behind, then sharply dorsiflex the foot rendering the posterior end of the talus clearly visible. With a wide osteotome cut the full width of the talus, parallel to and about ¼ inch below its upper articulating surface as illustrated in Figure 3. Enter the substance of the talus for at least ½ inch or more and make a greenstick fracture upward.

This fragment bearing the grooved area for impingement with the tibia, may be wedged up by small bone chips, obtained from the arthrodesis.

In one of the cadavers employed for this study there was an os trigomum or accessory bone making up the posterior end of the talus, which rendered this operative procedure impossible. The upper surface, however, was grooved exactly as if it had been the talus.

Osteotomy of the tibia. Represent the plane of the ankle joint by a straight line touching the anterior and posterior lips of the tibia, as illustrated in Figure 4. It is obvious that any mechanical scheme that will elevate the anterior lip or lower the posterior lip will alter the joint plane and incline it backward as shown in Figure 5. Plantar flexion of the foot will thus be restricted. The anterior margin can be elevated by a wedge-shaped

osteotomy from the front, or the posterior margin may be lowered by a linear osteotomy wedged open from behind.

Approach the anterior lower end of the tibia through a longitudinal incision placed to the mesial side of the extensor tendons. With the tendons retracted outward perform an anterior wedge-shaped osteotomy near the joint. It is seldom necessary to make the wedge more than ½ inch thick at the base. However, enough should be removed to permit impingement of the talus and tibia when the foot is at a right angle.

Inclination of the joint plane may also be obtained by a linear osteotomy on the posterior surface of the tibia, wedged open about ½ inch. After the tibia is cut through, sharply dorsiflex the foot and wedge bone chips into the gaping osteotomy until the talus and tibial margin meet, when the foot is released back to a right angle, as illustrated in Figure 6.

When either type of osteotomy is near the joint, considerable inclination of the ankle plane can be obtained without noticeable deformity. It is generally advisable to accompany the tibial osteotomy with a division of the fibula, if a thick wedge is removed from in front or inserted behind.

The majority of drop foot cases necessitates a lengthening of the Achilles tendon and would consequently render some posterior type of operation preferable. When Achilles tenoplasty is not required an anterior osteotomy of the tibia might be the procedure of election.

SUMMARY AND CONCLUSIONS

1. Four bone block operations are suggested for the relief of drop foot deformity.

2. Although the four operations are radically different, they all utilize the anatomically normal impinging mechanism between the tibia and talus.

3. These operations are clinically untried and unpublished and are presented only as surgical laboratory procedures, with the belief that they may have clinical application.

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HERNIA OF THE OVARY AND FALLOPIAN TUBE

A Record of Twenty-Five Cases

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ALTHOUGH hernia of the ovary and tube has been recognized and discussed from early times, it is only of recent years that any important papers have been published on the subject. Watson, in 1923, was able to collect 175 cases of hernia of the ovary and tube from the literature on the subject.

Although the site of the hernia varies, it may be said that about 90 per cent of herniæ of the ovary and tube are of the inguinal variety. In my series 22 were of this type. Next in frequency is the femoral variety which, however, is uncommon, only 3 out of my 25 cases coming under this classification. Although such rare conditions as obturator and sciatic herniæ of the ovary and tube have been recorded, they must be looked upon as extremely rare; no such case occurred in my series. In the 22 cases of inguinal hernia the ovary and tube were present as well. In the 3 cases of femoral hernia, however, in only 1 case did the fallopian tube accompany the ovary into the peritoneal sac. This seems to be the usual state of affairs, namely that inguinal hernia of the ovary without the fallopian tube can be looked upon as very uncommon, while in the femoral variety it is more common to find the ovary without the tube.

Among my cases there were none in which a pregnancy had taken place in the tube, but this is a possible complication which must be taken into account. Of 68 cases of hernia of the fallopian tube collected by Watson in 1923 from the literature of the subject, there was tubal pregnancy in 11. Ovarian pregnancy has also been recorded, but it is very rare. Probably the most frequent pathological change in old standing cases is cystic degeneration of the ovary. Large ovarian cysts have been removed from hernial sacs. Grant, in 1920, described an ovarian cyst which measured nearly 6 inches in length as occurring in a femoral hernia. A very few cases have been recorded in which malignant disease has supervened on a herniated ovary.

The *cause* of hernia of the ovary and tube is a very moot point, and for the lack of a better explanation we are constrained to fall back on a very wide term and say it is due to congenital predisposition. There can be no doubt, when looking through the published cases of this condition that the majority occur in girls under 1 year of age. The canal of Nuck is normally obliterated about the eighth month of intra-uterine life, but remains patent in some cases throughout life. The ovary does not, as a rule, descend into the pelvic cavity until the end of the first year of life and this may be the reason why so many cases occur before this date. In women it is more common to find the condition in those who have had several pregnancies, and in all probability this is due to the far greater mobility of the ovary and tube in such cases. In young children after one year other factors may act as exciting causes such as bronchitis or whooping cough. In the multiparous woman, any heavy lifting or laborious occupation must play its part in the production of these herniæ.

As regards the *symptoms* caused by these herniæ, they will mainly depend on the age of the patient. In young children the ovary appears as a hard, rounded swelling which is freely movable and is not tender. It may lie in the inguinal canal, at the external abdominal ring, or actually in the labium majus. In adult women the symptoms are more definite. The ovary is frequently hypersensitive and often painful on palpation. There is usually a history of enlargement of the ovary at each menstrual period; this swelling may be painless or, on the other hand, it may be so painful that it prevents the patient from walking about. If a rectal or vaginal examination is made in these cases the uterus will be found to be displaced to the side of the hernia. The complications which may arise in herniæ of the ovary and tube are not numerous, by far the most frequent being torsion and strangulation. In young children torsion is fairly common, and if it is long-continued it may result in strangulation. A case has been reported by Eustace and McNealy of strangulation of the ovary and tube in an infant 6 months old.

The only effective form of *treatment* is operation, treatment by trusses very rarely, if ever effecting a cure. There is a very real danger of atrophy of the ovary and cystic or degenerative changes may result owing to the pressure of the truss. The operation is very easy, and the

SUMMARY OF TWENTY-FIVE CASES OPERATED UPON AT KING'S COLLEGE HOSPITAL AND BELGRAVE HOSPITAL FOR CHILDREN

No.	Name	Age in years	Date of admission	Condition	Date of operation	Contents of hernial sac	Treatment adopted	Date of discharge	Remarks
1	D.M.	1 2/12	3-11-19	Right inguinal hernia	3-12-19	Ovary and fallopian tube	Replaced inside abdomen	3-23-19	
2	L.V.P.	4	5-29-19	Right inguinal hernia	5-30-19	Ovary and fallopian tube	Replaced	6-10-19	
3	S.P.	4 9/12	6-16-19	Left inguinal hernia	6-18-19	Ovary and fallopian tube	Replaced	6-28-19	
4	D.G.	1	1-14-20	Left inguinal hernia	1-15-20	Ovary and fallopian tube	Replaced	1-24-20	
5	D.E.F.	3/12	3-23-20	Right inguinal hernia	3-24-20	Ovary and fallopian tube	Replaced	4- 3-20	
6	A.P.	1 4/12	4-19-20	Right inguinal hernia	4-20-20	Ovary and fallopian tube	Replaced	4-29-20	
7	L.F.	9/12	2- 2-21	Right inguinal hernia	2- 4-21	Ovary and fallopian tube	Replaced	2-14-21	
8	H.A.T.	1 2/12	3-5 -21	Right femoral hernia	3- 5-21	Ovary, fallopian tube, and omentum	Ovary and tube excised	3-20-21	Strangulated ovary and tube. Ovary so engorged that it was four times its natural size.
9	W.L.F.	2	7-15-21	Left inguinal hernia	7-22-21	Ovary and fallopian tube	Replaced	8- 4-21	
10	T.H.	2	5- 7-22	Right inguinal hernia	5- 9-22	Ovary and fallopian tube	Replaced	5-25-22	
11	J.S.	4 4/12	5-24-22	Right inguinal hernia	6- 3-22	Ovary and fallopian tube	Replaced	6-15-22	
12	M.A.	9/12	5- 6-23	Right inguinal hernia	5- 7-23	Ovary and fallopian tube	Replaced	5-21-23	
13	B.A.G.	3	2-26-24	Right inguinal hernia	2-27-24	Ovary and fallopian tube	Replaced	3-12-24	
14	A.K.B.	47	4- 5-24	Right inguinal hernia	4- 7-24	Ovary and fallopian tube	Replaced	4-26-24	
15	R.R.	7/12	5-30-24	Left inguinal hernia	6- 4-24	Ovary and fallopian tube	Replaced	7-29-24	
16	D.A.D.	8	9- 8-24	Right inguinal hernia	9- 8-24	Ovary and fallopian tube	Ovary removed	9-20-24	Acute torsion of ovary.
17	J.K.	3 5/12	12-15-25	Left inguinal hernia	12-16-25	Ovary and fallopian tube	Replaced	12-29-25	
18	A.F.	45	6-11-26	Right inguinal hernia	6-18-26	Ovary and fallopian tube	Replaced	7- 1-26	
19	S.S.	35	6-11-26	Left femoral hernia	6-18-26	Ovary	Ovary removed	7- 2-26	Ovary was adherent to the sac wall and very fibrosed.
20	E.W.	29	4-21-27	Left inguinal hernia	4-29-27	Ovary and fallopian tube	Replaced	5-10-27	Patient was 3 months pregnant.
21	A.D.	53	5-17-27	Strangulated right inguinal hernia	5-17-27	Loop of small intestine, ovary, and tube	Ovary removed	6- 8-27	Acute torsion of ovary.
22	K.M.	56	8- 3-27	Double femoral hernia	8- 5-27	Ovary, tube, and omentum in sac on right side	Ovary removed	8-24-27	Ovary was adherent to sac wall and very fibrosed.
23	H.L.	55	2-10-28	Right inguinal hernia	2-12-28	Ovary and fallopian tube	Ovary removed	2-28-28	Ovary twisted and adherent to sac wall.
24	A.E.	1 2/12	5- 3-28	Right inguinal hernia	5- 5-28	Ovary and fallopian tube	Replaced	5-20-28	
25	G.B.	1 11/12	8-23-28	Left inguinal hernia	8-24-28	Ovary, tube, and uterus	Ovary removed. Tube and uterus replaced	9- 6-28	

mortality exceptionally low. The ovary and tube can be returned to the abdomen and the hernial sac excised. Where torsion or strangulation have occurred, however, excision should be performed, as a useless fibrotic ovary always results from these complications.

The 25 cases tabulated have occurred in a series of inguinal and femoral herniæ in females who have been operated upon at King's College Hospital and the Belgrave Hospital for Children in London during the years 1919–1929. I wish to thank my surgical colleagues attached to these hospitals for allowing me to make use of their notes on the cases. In this series there were 300 cases of inguinal herniæ and 200 cases of femoral herniæ. Of the femoral cases 196 occurred at King's College Hospital and 4 only at the Belgrave Hospital for Children. Femoral hernia in children must be looked upon as a very rare condition, and, according to Rutherford, occurs in about 0.4 per cent of the cases which have been recorded.

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RUPTURE OF THE SPLEEN

A REPORT OF TWENTY-SEVEN CASES

LEO DRETZKA, M.D., F.A.C.S., DETROIT, MICHIGAN

ALTHOUGH the spleen lies hidden in a protected recess, it is frequently lacerated, macerated, and perforated by crushing injuries, bullets, and stabs. Its vascularity is so extensive that injuries to it result in a high mortality rate. Associated trauma is not infrequent; especially is this the case in bullet wounds.

Connors reviews a series of 39 cases, which came under his observation at the Harlem Hospital in New York. In his group, the greatest number of cases were due to automobile accidents, while the majority in the writer's series were caused by gunshot wounds.

The present collected group were operated upon in the City of Detroit Receiving Hospital. The predominating factor causing the injury was the bullet. Of 27 cases operated upon, 14 were gunshot wounds, 9 the result of automobile accidents, 2 were caused by falls, and 2 were stab injuries. Of this group, 17 lived and 10 died. Eight of the 10 fatal cases were complicated by extensive injuries to organs other than the spleen (Table I).

The majority of patients were adults, all in the active period of life. The youngest victim was 11 years and was struck by an automobile. The oldest was 42 years. The adult age range was from 21 to 42 years. Of the total number, 7 were females. Industry did not contribute to the fatalities to any extent. The majority of injuries were the result of social warfare and traffic.

SYMPTOMS AND SIGNS

Evidence of profound systemic shock is present in the majority of cases, the degree depending on the extent of the laceration with its resultant hæmorrhage and the involvement of neighboring organs. If the symptoms are more or less mild, it may be assumed that the injury produced only a subcapsular hæmatoma or slight rent in the capsule. That this is not an infrequent lesion is evidenced by postmortem findings of this nature in 3 cases, not in this series, where the fatal lesion was brain laceration and skull fracture. The bleeding from the slight laceration of the spleen was controlled by clotted blood and had these cases been free from complications, surgical interference would not have been warranted.

The symptoms are usually those of severe intra-abdominal hæmorrhage. The face is pale and pinched in appearance. The lips are dry and beads of perspiration are present on the skin. The pulse is rapid, weak, and thready. Rigidity is usually general but may be confined to the upper left hypochondrium. Localization of pain in this region is an important symptom, as perforation of the spleen, kidney, or liver produces more severe pain than does a similar injury to the hollow viscus. The symptom of referred pain is of little value, since the victim is frequently in a confused, shocked mental state. Dullness on percussion in the left flank is an important symptom. There was no case of unconsciousness in the pres-

ent group. Four were described as semiconscious, which can be readily attributed to profound shock. Low systolic blood pressure is a common finding and a valuable guide in determining the time of operation. Abdominal rigidity and pain to a greater or lesser degree were present in all of the patients. In the majority, these symptoms were localized in the left hypochondrium. Nausea and vomiting are not uncommon symptoms. Keen observation of vague symptoms is imperative in all types of abdominal injury. The following case well illustrates a spleen rupture in an unsuspected case.

R. L., aged 17 years, fainted on the street and was brought to the hospital. Four days previous to admission, he fell against a wire fence injuring the left side of his abdomen. He was taken to a private hospital for examination and immediately discharged with a diagnosis of minor injury. He returned to work the following day, but was weak and faint. His parents noticed his palor and general debility. As stated, he was brought to the hospital 4 days after injury. Operation disclosed massive blood clots in the abdomen. There was a large laceration on the left lobe of the liver and a laceration of the upper pole of the spleen. Stimulation, blood transfusion, and other postoperative measures failed, and the patient expired. It is reasonable to believe that death was due to the failure of early diagnosis.

DIAGNOSIS

History of an injury, and most frequently an external wound in the upper left hypochondrium, together with symptoms of internal hæmorrhage, leaves little doubt as to the diagnosis. Intra-abdominal trauma with hæmorrhage makes an exploratory laparotomy imperative, and the surgeon must be prepared for any emergency. When the site of a blow is localized in the left upper quadrant of the abdomen, the liver may be free from injury, but in gunshot wounds that organ is frequently involved together with the spleen. Trauma to the hollow viscus gives rise to a more generalized rigidity and the accompanying pain is less profound. Vomiting is present more often in intestinal and stomach perforation than in laceration of the spleen; its diagnostic value is doubtful except that it indicates intra-abdominal trauma.

SURGICAL PATHOLOGY

The effects of splenectomy, both in man and animals, seem to indicate that the function of the spleen is assumed by the remaining reticulo-endothelial system. It is regrettable that it is so difficult to follow up our traumatic cases; for here we remove apparently a normal organ (though injured) from an essentially normal individual. Mayo and Archibald state: "In accidents where the spleen is ruptured, it will very often be found that a pathological condition existed previously and resulted in enlargement and friability of the organ." This is contrary to the findings in the present series, where none of the injured spleens was grossly pathological, and the specimens removed disclosed no microscopic pathology indicating disease.

Boyd observes: "The red cells of the blood are diminished in number, but seldom below 3,000,000, and the anæmia disappears by the end of 2 months. A leucocytosis, due mainly to an increase in the number of the polymorphonuclears, persists for about 4 months. A rise to over 30,000 occurs shortly after the operation, but in a few days' time it drops to 20,000." In the present series, the admission blood examination was omitted in the majority of the cases. The postoperative cystology shows an increase in polymorphonuclear leucocytes and a decrease in hæmoglobin and red cells. The white cell count ranges from 8,250 to 42,000 white blood cells. There were urinary complications in 6 cases, and in 3 a positive blood Wassermann.

Trauma caused by gunshot or stab wounds is usually not so destructive to the organ as are crushing accidental injuries. The circumscribed wound in the spleen, therefore, frequently permits the use of the tampon or suture, whereas, a crushing injury causes extensive laceration and demands a splenectomy. The least protected lower portion of the organ is most frequently affected. Although all degrees of wounds are encountered, as perforating, gutter, lacerating, and macerating, bullet wounds involve neighboring organs more constantly than does trauma of other varieties. As in Case D 671, a gunshot wound in the left eighth interspace caused a perforation of the spleen, stomach, and liver.

TREATMENT

The two factors to be placed in the balance when confronted with a case of intra-abdominal hæmorrhage are the patient's resistance to additional operative trauma, and the knowledge that delay beyond a certain point is fatal. To operate on a patient suffering with systemic shock is unpardonable. The victim should be removed to a warm bed and every means at the surgeon's disposal used to stimulate the depleted system and re-establish the blood pressure. Intravenous injections of saline and glucose are immediately available; while these aids are effected, preparations for a direct transfusion of blood are made. The transfusion is best given without removing the patient to an operating room. Auto transfusion of abdominal blood is possible in selected cases, provided the surgeon is positive

TABLE I.—TABULATION OF CASES—FIVE YEAR PERIOD

Case	Age	Sex	Type of injury	Prominent admission symptoms	Operative findings	Treatment spleen	Lived	Died	Stay in hospital
B2778	11	M	Automobile accident	Pain, rigid abdomen, shock	Extensive laceration of spleen	Mattress suture	Yes		20 days
S1	25	F	Thrown against curb	Severe pain, contusion of left chest, fracture 8th and 9th ribs	Laceration of spleen	Splenectomy	Yes		22 days
G12723	20	M	Gunshot wound abdomen and left arm	Rigidity, nausea, and pain	Perforation of lower angle of spleen	Suture and pack	Yes		10 days
G13984	19	F	Automobile accident	Pain, vomiting, rigidity, distention	Transfusion. Postmortem rupture of spleen. Rupture right and left kidney	Postmortem		Yes	6 hours
G7021	33	M	Stab wound in left back	Several body wounds, vomiting, rigidity, alcoholism	Puncture wound of spleen	Mattress suture	Yes		17 days
S2	29	M	Fall in suicide attempt	Body contusions, shock, no rigidity, fractured arm	Maceration of spleen. Free blood clots	Splenectomy	Yes		29 days
S3	40	M	Gunshot wound under left rib margin	Localized rigidity, nausea, shock	Puncture wound of spleen. Some free blood	Gauze pack	Yes		12 days
S4	32	M	Stab wound left back	Rigidity, abdominal distention, vomiting	Laceration of spleen, perforation of stomach	Gauze pack and suture		Yes	3 days
F18841	31	F	Gunshot wound in abdomen	Shock, pain, nausea, rigidity	Several perforations of small bowel, omentum, perforation of spleen	Gauze pack in perforation		Yes	1 day
G7032	26	M	Stab wound eighth interspace	Shock, pain, rigidity, alcoholism	Laceration of spleen and puncture of diaphragm	Splenectomy	Yes		16 days
15367	42	M	Gunshot wound right arm, chest, abdomen	Alcoholic stupor, shock, rigidity	Laceration of liver, perforation of spleen	Gauze pack and mattress suture of liver		Yes	4 days
D3593	25	M	Gunshot wound of chest, ninth interspace	Mild shock, no rigidity, severe pain	Perforation in lower margin of spleen. Free blood	Gauze pack	Yes		14 days
D671	26	F	Suicide attempt. Gunshot wound left chest	Semiconscious, pain, slight rigidity	Perforation anterior and posterior walls of stomach. Laceration of liver and laceration of spleen	Splenectomy	Yes		30 days
C13472	28	M	Gunshot wound of abdomen and right leg	Profound shock	Laceration of spleen, liver, perforation anterior wall of stomach	Suture and pack		Yes	1 day
C3868	23	M	Gunshot wound in left back	Pain, shock, rigidity	Puncture wound of spleen	Pack	Yes		25 days
12803	38	M	Struck by automobile	Abdominal pain, severe shock, distention	Extensive laceration of spleen. Free blood clots	Splenectomy		Yes	5 days
D7784	26	F	Struck by automobile	Shock, rigidity, upper left quadrant, nausea, no distention	Several lacerations of spleen	Splenectomy	Yes		28 days
D8040	22	M	Fall into pit	Confused mentally, severe pain, no rigidity	Extensive rupture of spleen, free blood and clots	Splenectomy	Yes		14 days
F348	21	M	Gunshot wound	Shock, rigidity upper quadrant, hæmorrhage from nose and mouth	Single perforation of spleen. Perforation of liver	Gauze pack in spleen and liver. Blood transfusion		Yes	21 days
F11123	17	M	Four days previous to admission fell against fence	Shock, pain in upper abdomen, rigidity, pain, abdominal dullness	Laceration of spleen and liver. Massive blood clots	Gauze pack and mattress suture. Blood transfusion		Yes	3 hours
F15096	26	M	Automobile collision	Shock, abdominal pain, retention of urine. Semiconscious	Laceration upper and middle aspect of spleen	Gauze pack	Yes		18 days
F16687	31	M	Gunshot wound in left back	Shock, semi-conscious, upper abdominal rigidity, pain	Double laceration of liver, laceration of spleen. Massive blood clots	Suture and gauze pack		Yes	2 days
F1725	21	M	Gunshot wound axillary line ninth rib	Pain, rigidity, shock	Severe laceration at hilus of spleen	Splenectomy		Yes	2 days
F18811	40	M	Gunshot wound of back, tenth interspace	Shock, pain, rigidity upper left quadrant	Laceration of spleen	Gauze pack	Yes		21 days
13415	38	F	Gunshot wound left upper quadrant	Rigidity, pain, mental confusion	Laceration at hilus of spleen. Free blood	Splenectomy	Yes		14 days
D12238	38	M	Gunshot wound left abdomen and left forearm	Pain, shock, upper abdominal rigidity	Laceration lower angle of spleen	Suture and pack	Yes		22 days
G16561	27	M	Stab wound left upper quadrant with herniation of omentum	Pain, not in shock, rigidity localized	Two puncture wounds of spleen, active bleeding, and free blood in abdomen	Suture	Yes		11 days

TABLE II.—RECOVERED CASES—INTERVAL BETWEEN ADMISSION AND OPERATION

	Cases
Less than 1 hour	2
Less than 2 hours	4
Less than 3 hours	2
Less than 5 hours	5
Less than 6 hours	1
Less than 7 hours	3
	17

TABLE III.—FATAL CASES—INTERVAL BETWEEN ADMISSION AND OPERATION

	Cases
Less than 1 hour	7
Less than 2 hours	2
Less than 5 hours	1
	10

TABLE IV.—OPERATIVE PROCEDURES

	Lived	Died
Splenectomy	7	2
Suture	3	..
Suture and pack	2	5
Pack	5	2

that it is not contaminated by a perforation from the hollow viscus. This method has, however, not been resorted to in this series. When the patient has reacted sufficiently to warrant interference, the operation may be done. Delay in the operating room is a serious factor, and all details need to be arranged before the patient is removed from his heated bed.

Spinal anæsthesia should be used if possible. It produces more complete relaxation and exploration can be carried out more thoroughly. The possible fall in blood pressure sometimes acts as an aid in controlling massive hæmorrhage.

The operation must be performed quickly and as gently as possible. Exposed viscera should be covered with warm sterile pads and replaced in the abdominal cavity without delay. A splenectomy or suture of the organ cannot be done unless the incision is ample. A long incision at the beginning of an operation will often save the surgeon much distress. A rent in the capsule may be conveniently treated by a mattress suture, and this is also true of a puncture or stab wound. Catgut is preferable to the non-absorbable material. The suture must be inserted with gentleness and tied with caution. No case of secondary hæmorrhage was encountered in this series, although this complication is conceivable in the group of tamponed cases. Injuries to the vessels near or at the hilum cause massive hæmorrhage and immediate splenectomy is indicated rather than suture or tampon. Extensive laceration and maceration of the organ should also be treated by splenectomy.

After the troublesome hæmorrhage has been controlled, a minute inspection must be made of the neighboring organs. If the surgeon is satisfied that the viscera are undamaged, then the wound is closed without drainage.

Postoperative stimulation is essential. Infusion of saline and glucose was given in every case and if necessary, direct transfusion of blood should be repeated after the patient has been returned to his bed.

CONCLUSIONS

1. Splenectomy is superior to suture or tampon when the laceration or maceration is extensive or if the lesion involves the hilum of the spleen.

2. Suture or tampon readily controls bleeding in the majority of the stab or bullet wounds.

3. Secondary hæmorrhage has not been encountered in this series.

4. The pre-operative treatment of shock is essential.

5. Complications are frequent and account for the high mortality rate in this type of injury.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST, 1930

AGAIN THE CANCER PROBLEM

THE recent use of an extract of suprarenal cortex, in combating cancer, has received such wide publicity as again to attract general attention to the cancer problem. The question arises: what can we tell the laity about cancer?

First, it can be said that cancer never develops in sound tissues, and this knowledge is manifested in the understanding of physicians of the danger of permitting sources of chronic irritation to continue. Second, in the early stages of malignant change surgical removal of the growth, or, in suitable cases, the use of radiotherapy gives a high percentage of cures.

It is difficult, however, for the laity to appreciate to what extent cure is possible in cancer, and in their very fear of a condition which they believe to be hopeless they often delay surgical consultation. This widespread pessimism exists because when death occurs from cancer, the cause of death cannot be concealed, whereas persons who have been operated on successfully for cancer hide the fact that they have had malignant disease because general knowledge of it would stand in the way of their future advancement. As a consequence the public has known much of the horrors of the disease and little of its curability.

The close relation of chronic irritation to cancer of the visible surfaces of the body cannot be controverted. For instance, cancer of the scalp is common among the Chinese, who shave the head with dull and rough-edged instruments, and is uncommon among peoples who do not have this practice. In China the men eat at the first table, when the rice is hot, and their practice of throwing the rice by means of chopsticks with considerable force into the posterior part of the pharynx and the first portion of the œsophagus, results frequently in cancer in this situation. The Chinese women, who eat at the second table when the rice is cold, do not often so suffer.

A form of cancer of the mucous membrane of the mouth which is common in the Philippines and in parts of India, is the result of chewing the betel nut, which, wrapped in its leaf with lime, is carried almost constantly in the cheek. Note the great reduction in cancer of the mouth and about the gums as the result of good dentistry, and in cancer of the lip with the disappearance of the clay pipe. It is said that cancer of the breast, so common in civilized women, has no corresponding frequency in women of those races who leave the breasts exposed. In the mountains of Kashmir, where the natives carry charcoal braziers filled with hot coals strapped to the lower abdomen, cancer of the skin just above the pubes is common.

The relation of chronic irritation to cancer of the external surfaces of the body is paral-

leled by cancers of the internal surfaces, but the evidence is necessarily indirect.

Cancer of the gall bladder is seldom seen except in connection with gall stones, and even those investigators who do not believe that cancer of the stomach often has its origin in ulcer, admit that cancer on ulcer does occur in a percentage of cases which Hurst, of Guy's Hospital, London, puts at about 20 per cent. In our own experience, while the percentage in which the histological examination of excised cancers of the stomach for evidence of preceding ulcer varies in different series of cases, the development of gastric cancer on some type of demonstrable precancerous disease, such as ulcer, is present in more than 25 per cent. When cancer of the mesoblastic structures occurs, the preceding source of chronic irritation is probably biochemical in nature.

When we attempt to explain what happens in chronic irritation in relation to cancer, there are two outstanding points of view.

First, it is believed that some microorganism or other outside agent enters the body and gives rise to cancerous growth. However, if this were true, secondary cancers would show the histopathological characteristics of the organ in which they occurred, whereas they show those of the original lesion. For instance, if a cancer originating as an adenocarcinoma of the mucous membrane of the stomach extends to the liver by metastasis, the new-growth proves to be not a cancer of the liver, but a cancer of the mucous membrane of the stomach in the liver, proving that the malignant cell itself has been transplanted to the liver, and is itself parasitic.

Second, it is equally probable that when a breach of continuity in the tissues occurs as the result of long-continued chronic irritation, the attempt is made first to heal the defect with normal cells, but in the course of time, as the reparative processes are exhausted, cells less and less mature are thrown into the breach, until finally embryonic cells, but the best that can be supplied, replace the normal epithelium and take on malignant change.

This brings up an interesting side line of thought, and that is that the age of cells and their condition must play a prominent part in the development of malignant disease. Perhaps the reason cancer usually appears after middle age is that the cells of the body have lost the reparative power of youth, have a lessened immunity, and thereby have become more vulnerable. Again those organs of the body which have a relatively short heredity are more often involved than organs which we know to be more primitive and which might be said thereby to have gained hereditary resistance to the disease.

In this connection, the frequency of cancer of the stomach and of the large intestine and rectum, what might be called modern organs of convenience, as contrasted with the infrequency of cancer of the more primitive small intestine with its ancient heredity, is suggestive. Malignant disease of the testis, which is the primitive organ, is rare as contrasted with the many varieties of malignant disease of the ovary, a relatively recent organ derived from the primitive testicle. One can carry such a theory still further and point out the great incidence of cancer of the breast and the uterus in women at the menopause, whereas in men there is no such frequency of cancer in the generative organs, because no comparable senile change takes place.

If we attempt to visualize the problem of cancer, therefore, certain factors must be borne in mind. The age and the condition of the bodily cells, especially those cells that have a protective function, must be considered. Again, those organs of the body, the breast and the uterus, which undergo early senility,

carry with them an increasing risk of cancer, and finally, the only reasonable explanation why 90 per cent of persons do not have cancer and why 10 per cent do have cancer is that there is a varying degree of immunity in individuals to the cause or causes of cancer, which leads to the hope that resistance to this disease may be increased as it has been in other diseases of man. W. J. MAYO.

POSTOPERATIVE PULMONARY COMPLICATIONS

ONE result of the researches conducted on the important question of etiology of postoperative pulmonary complications has been the development of two schools whose members explain the phenomena along widely divergent lines. In the case of the aspiration hypothesis, there has been much carefully conducted experimentation presenting the evidence quite logically, and an equal amount, fully as scientifically supervised, apparently proving beyond cavil that acute pulmonary lesions following surgical operations are purely embolic in origin. A third school, of more recent origin, emphasizes the frequency of massive or lobular atelectasis resulting from bronchial obstruction.

Cutler concludes that pulmonary abscesses result most commonly from infected emboli; that, only with difficulty, can abscess be produced in the experimental animal by the insufflation and aspiration of anaerobic or aerobic organisms; and that aspiration of buccal contents is a usual occurrence in patients submitted to general anæsthesia. The same conclusions are reached by Van Allen, Adams, and Hrdinia. From an experimental study conducted recently by Holman and Mathes, it was found that emboli must be *infected* to produce marked pathological changes in the lung—that sterile emboli produce but little gross evidence of their presence. Flick, in a clinical study of 172 cases of abscess of the lung, found that 62 per cent followed tonsillectomy and oral infections. Most writers find a high incidence of abscess following respiratory tract operations, but this is not the finding with the other and more common pulmonary complications, collapse, pneumonia, infarction, etc.

By a long continued and carefully conducted investigation, Whipple has added greatly to our knowledge of this subject and has lead the school of proponents of the aspiration theory. That bronchial aspiration commonly occurs when patients are under general anæsthesia and that pulmonary diseases only rarely result therefrom is, however, being frequently and consistently demonstrated. May, Thoburn, and Rosenberger have recently studied, radiographically, the aspiration of iodized oil into the bronchial tree of patients undergoing tonsillectomies and conclude that some aspiration is unavoidable in all operations requiring an inhalation anæsthetic. In a series of patients studied by them, it was found that aspiration occurred in 48 per cent. Similar conclusions were reached by Myerson who, in a series of two hundred cases, reports an aspiration percentage of 75; while the Dailys', in their series of one hundred cases, report aspiration as occurring in 78 per cent. In one hundred bronchoscopies performed after tonsillectomy, Iglauer and his associates report aspiration of mucus or tissue particles as occurring in 40 per cent.

The recent work of Lee, Tucker, Ravdin, and Pendergrass has cast much light on the question of the etiology of massive collapse and has demonstrated the rôle, possibly the leading one, of bronchial obstruction with tenacious mucus, in producing the condition. However, certain of these contentions are questioned in a subsequent study made by

Muller, Overholdt, and Pendergrass. These students of the problem demonstrated that, roentgenologically and on physical examination, many patients show signs far out of proportion to the symptoms. Also, that on the first postoperative day, average pulmonary vital capacity is but 33 per cent of the pre-operative reading. It is held that hypoventilation of the lungs, especially after upper abdominal operations, is the usual state and should be regarded as normal. The follow-up of Lee, Wilmer, and Cobe in their cases of postoperative massive atelectasis has shown that these patients were asthmatic or were definitely allergic in every case. This would seem to suggest that we have another etiological factor in this phenomenon which should be carefully studied.

Foss and Kupp, studying the pulmonary complications following more than four thousand general surgical operations and four thousand operations on the nose and throat, all performed in the same hospital with same anæsthetists and paralleled operating room technique, found an incidence of 1.7 per cent on the general service, while there were no cases of pulmonary complications whatever on the nose and throat service. The incidence of pulmonary complications following spinal anæsthesia was found to be as great as with patients who were operated upon under general inhalation anæsthetics. They further conclude that their studies strengthen the theory that embolism plays the chief rôle in the production of most postoperative pulmonary complications and that: (1) infarctions (minor emboli) are far more common than has been generally supposed; (2) aspiration plays but a minor rôle in the production of pulmonary complications; (3) pulmonary complications are, relatively, infinitely less common following operations on the upper respiratory tract than following operations on the abdomen and pelvis; (4) irritation by the anæsthetic or the aspiration of foreign substances during inhalation anæsthesia probably plays a part in the production of postoperative bronchitis and pneumonia (however, the fact that these complications follow spinal and even local infiltration anæsthesia with great frequency suggests that other factors are of equal importance); (5) the incidence of post-pulmonary complication is as high following spinal anæsthesia as after general inhalation anæsthesia.

Whatever the condition, whether the aspiration pneumonitis of Whipple, the embolic processes of Cutler, the atelectasis of Lee and his co-workers, or a combination of all these and others yet undiscovered, the treatment advocated in prophylaxis of massive collapse seems to apply equally well to all anticipated postoperative pulmonary complications, namely: (1) hyperventilation during and after operation with carbon dioxide and oxygen, as advocated by Scott and Cutler; (2) change in the position of the patient every 6 hours, after operation (Sante); (3) curtailment of postoperative sedatives, especially those which depress the cough reflex. The use of desiccated thyroid, as recently suggested by Walters, seems completely to prevent the development of postoperative pulmonary embolism. This advice should be carried out with all cases of suspected pulmonary complications —better still, routinely, with all operative patients seriously ill. Finally, when symptoms definitely appear, there is the oxygen tent, our newest and, perhaps, most effective aid. Muller routinely places all of his patients suffering with perforated peptic ulcer in the tent—an excellent plan that might be followed with all seriously ill surgical patients who are in danger of developing respiratory complications.

HAROLD L. FOSS.

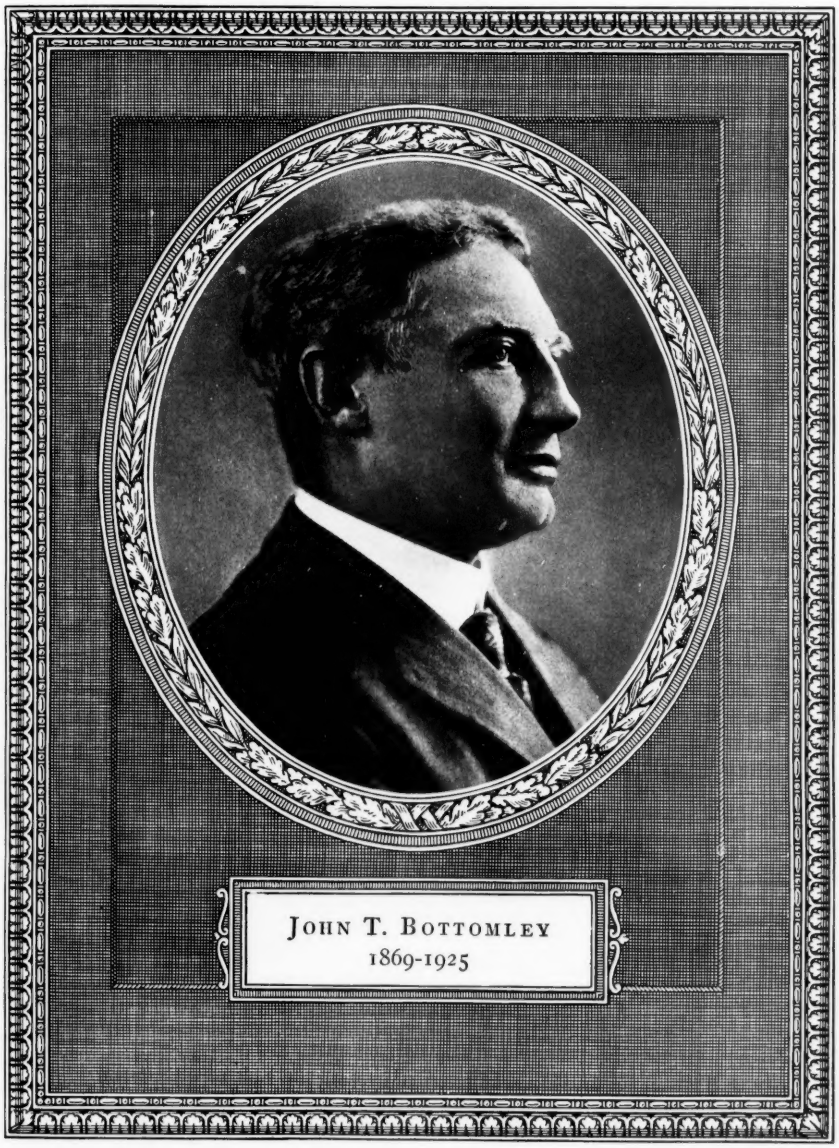
MASTER SURGEONS OF AMERICA

JOHN T. BOTTOMLEY

A BRIEF review of the life and surgical career of the late Dr. John T. Bottomley of Boston, Massachusetts, will make evident the fact that in his sudden death in December, 1925, at the age of 56, in the full tide of his activities, the surgical profession of this country lost one of its leaders and New England one of its most valued and popular consultants. He was born in Lee, Massachusetts, on September 24, 1869. He graduated from Holy Cross College in 1889 and from the Harvard Medical School in 1894. In school he was an enthusiastic and intelligent student, and stood near the head of his class. He then went to work as interne at the Boston City Hospital, where the writer first knew him. His efficiency, ability, and the cheerfulness with which he went at his work endeared him to the staff and to his patients. He was honest, kindly, sympathetic, and resourceful. He just could not do enough in his efforts to relieve suffering. During the Spanish-American war he was assistant surgeon to the late Dr. H. L. Burrell on the Hospital Ship Bay State. Well or seasick, he was the same cheerful, willing worker and exerted himself to the utmost in the cure of the typhoid and tropical diseases which characterized that war.

In 1897 he began practice in Boston and soon (in 1899) was appointed to the staff of the Boston City Hospital. He was made supervising surgeon to the Relief Station in Haymarket Square, where he made a name for himself in major traumatic surgery. At the City Hospital he made a special study of the relief of distention and tympanites after laparotomy, and added real contributions to the treatment of these cases.

In 1902 he went with Dr. John C. Munro to the Carney Hospital, one of the hospitals of the Sisters of Charity. There these two men did pioneer work, especially in placing on a firm basis the surgery of ulcer and cancer of the stomach. Also, in the subject of the surgery of the gall bladder, they contributed much. Together these two men built up an active and progressive clinic, where the work attracted frequent visits from the surgical societies of the country, as well as visits of individual leaders in our art. On the death of Dr. Munro in 1910, Dr. Bottomley succeeded to his position and carried on the work with undiminished energy. His loyalty to his chief was a fine feature of their association. He was in great demand as a consultant throughout New England and was consult-



JOHN T. BOTTOMLEY
1869-1925

ing surgeon to twelve hospitals. He gave freely of his time and strength and made a reputation not only for surgical skill, but for wisdom, honesty, and kindness. He never spared himself, and when not with his work at the Carney was constantly on the move over New England.

He always took time to visit the great clinics of the country and was a member of the Society of Clinical Surgery and of the American Surgical Association, where his cheerfulness and sunny disposition won him many friendships, which were both strong and lasting. He surely was the prince of good comrades. To the scientific proceedings of these societies he made many valuable contributions, which were characterized chiefly by sanity and good sense. He loved books and art and had a wonderful collection of old medical prints, as well as rare old books, both in medicine and general literature.

During the World War he was a captain in the medical corps and used his good judgment efficiently in the examination of candidates for the medical service. He also served as advisor to the draft boards. In this work, as with everything that he did, he spared no expenditure of time and strength.

He was a member of the Roman Catholic Church and, wherever he might be, never neglected his religious duties. The eulogy at his funeral by Monsignor Splaine was one of the finest tributes ever paid to a member of our profession. In his family life he was most happy. In 1908 he married Mary Agnes Kenney, of Boston, who with five children—three sons and two daughters—survives him. About two years before his death he suffered from an infected finger, associated with a septicæmia, which affected his heart and kept him away from his practice for several months. Then he went to work again, but was obliged to limit his activities in some degree, although the demands upon him were constant. He had operated at two hospitals on the morning of the day he died. Death came to him instantly and painlessly. His many patients, friends, and his fellow surgeons all over this country will not soon forget big, strong, cheerful, smiling, competent John Bottomley.

FRED. B. LUND

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA, NEBRASKA

THE COLLECTED WORKS OF JEROME CAPIVACCEUS

IT is interesting to note what one of these so-called educated internists of the sixteenth century had to say regarding surgery as it applied to his field of internal medicine. Hieronymus Capivacceus, or Jerome Capivaccio, was born at Padua during the early part of the sixteenth century. Unlike the majority of the medical men of his time, he did not travel around from place to place but contented himself with remaining in his native city where he took his medical education at the University of Padua. Presumably following the receipt of his doctor's degree he continued to work at the university, for in 1552 he was given a subordinate professorial position in the medical department, and in 1564 was appointed the regular professor of medicine in the university. He was a man of great learning. He knew the ancient languages and his knowledge of the works of his predecessors in medicine was considerable. He attained a wide reputation, and in 1587 was called by the Grand Duke of Tuscany to the chair of medicine at the University of Pisa, but this he declined in order to stay in Padua and there he remained in his native town until his death in 1589. He was particularly interested in the treatment of syphilis and tells us at the end of his chapter on the treatment of that disease that he made over 18,000 ducats in the treatment of this ailment alone. It is rather worthy of note that he mentions, as the surgical treatment of this disease, the ever present phlebotomy and also the use of the cautery on venereal ulcers and other skin lesions.

Capivacceus' work was practically all published after his death. According to the bibliography, as given by Gurlt, the first work to appear under his name was on *Lues Venerea*. This appeared in 1590. When the first edition of his entire work was printed I am unable to state. The edition here illustrated was printed in 1601 and is stated to be the third edition of the work. It contains all of the individual works of Capivacceus which had been published up to that time in one large folio volume. It is devoted almost entirely to internal medicine, but in the discussion of the cure of the various diseases there is usually an article devoted to the surgical treatment. This is nearly always nothing more or less than the indication for phlebotomy in the disease accompanied by directions as to where the blood should be drawn and how much blood should be taken. Throughout the entire work, Capivacceus constantly refers to Galen and the Arabian physicians and seems to take them as the last word regarding both diagnosis and treatment. Here and there, however, he refers to surgical methods aside from venesection, non-operative it is true, but at the same time interesting. For example, in his discussion of angina, which he describes as an inflammation of the throat and upper portion of the pharynx, he tells of the method of passing a tube into the stomach in order to introduce food when swallowing becomes extremely difficult. He says, however, that this may irritate the parts and make swallowing still more difficult. He suggests the passage of a tube down to the beginning of the œsophagus. He then places at the proximal end of the tube a clean animal bladder which he has filled with liquid nourishment and by squeezing on the bladder squirts it into the œsophagus and so into the stomach. In stricture of the œsophagus he writes as follows: "Therefore as to the surgical treatment. If deglutition is difficult and medicines are not able to diminish the difficulty it is necessary to pass waxed candles into the œsophagus and by the benefits of these many are restored to health. Aetius says, if the difficulty is from paralysis it is necessary to affix cups to the chin." Apparently by his candles or wax bougies he dilates the stricture.

In the third chapter of the third book which is entitled "Concerning Diseases of the Stomach," he gives his general idea as to the field of surgery in the treatment of disease. He speaks of surgical method being divided into two parts, either bloody or non-bloody. In the bloody method he includes the uses of venesection, leeches, and cups. He then goes on and gives Galen's ideas as to the use of incision in abscesses of different parts of the body and includes this in the non-bloody classification. He states that it is the wisest thing to wait until the pus can be seen beneath the skin before the incision, which should be over the most prominent part, is made. In the eighteenth chapter of the third book under the heading of diseases of the liver, in which he takes up ascites and anasarca, he advises the various types of puncture which were current at the time. In ascites he advises puncture beneath the umbilicus into the abdomen and the withdrawal of the fluid, and in general anasarca, in which the thighs are swollen and in some cases the scrotum, he advises making incisions in the skin to allow the serum to drain out.

HIERONYMI CAPIVACCEI

PATAVINI,

MEDICI, AC PHILOSOPHI PRAECLARISSIMI.

In Patauino Gymnasio Praxim admirabili cum laude publicè professi.

MEDICINA PRACTICA. SIVE METHODVS COGNOSCENDORVM, & curandorum omnium corporis humani affectuum;

Nunc denuò edita, & in multis iuxta germanas Authoris lectiones, & potissimum circa febres adaucta, atque omni diligentia absoluta.

Cui adiecta sunt & reliqua, quæ adhuc extant, eiusdem Excellentissimi Viri

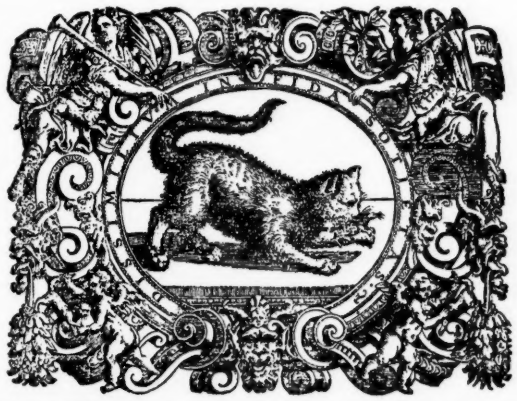
OPERA OMNIA

Quæ postremo in hac tertia Editione duobus Tractatibus; Altero quidem DE FOETVS FORMATIONE, reliquo vero de PVLSIBVS, ac non EXPOSITIONE in Primum librum Aphorismorum Hippocratis; ac de ARTE COLLEGIANDI, & MODO INTERROGANDI ÆGROS locupletata sunt,

INDVSTRIA, ac Labore EONCII LEONIS Tergestini Medici Physici.

Accesserunt Indices tùm Librorum, & capitum; tùm rerum, & verborum locupletissimi.

CVM PRIVILEGIIS.



VENETIIS, M DC I.

Apud Hæredes Melchioris Sessæ.

REVIEWS OF NEW BOOKS

IN a volume of 392 pages, Bourne and Stone[1] have attempted "to collect what are accepted as the most constant clinical pathological findings in disease, to state when the result of a test whether positive or negative is of value, and to record when such a test is worth doing and when it is incapable of giving help." This is, therefore, something of a new departure in medical books. It is concerned with the "no man's land" between textbooks of clinical pathology which are likely to be filled with minutiæ of technique and textbooks of medicine which cannot afford to emphasize the interpretation of clinical pathological findings without losing balance or becoming unduly bulky. The subject matter of most of the chapters has been arranged in a uniform manner. Under the heading "General Considerations" has been gathered sufficient of the facts concerning the pathology of the disease to render the origin of the clinical pathological findings understandable. The chief of these findings are then enumerated. Finally, the bearing of each individual result of laboratory tests upon diagnosis, prognosis, and treatment is discussed. "No medical man should ask for a special investigation without knowing to what extent a positive, a negative, or an equivocal answer will react upon his clinical conception of the case." If all clinicians would observe this principle both they and laboratory workers would be saved much trouble and confusion. The contents of this book have been chosen to assist the clinician in using such knowledge and in observing this principle. This volume should prove eminently useful to internists, surgeons, and clinical pathologists. J. P. SIMONDS.

IN past decades when careful laboratory preoperative diagnosis was the exception rather than the rule, among the disasters encountered, and such disasters still occur, was that of failing to recognize a diabetic. The diabetic develops the same surgical lesions as the normal individual; he is particularly susceptible to one group, namely, infection and gangrene. The key to successful surgery in diabetics is the control of sugar metabolism.

The first part of *Diabetic Surgery*[2] is devoted to the study of the incidents of diabetic surgery, the risks of such surgery, the medical problems of insulin and diet, and anæsthesia. The second half is devoted to gangrene of the extremities, carbuncles and other skin infections, abdominal surgery, hyperthyroidism, and malignancy.

The general survey of the chemistry and dietary control, while brief, is intelligent and ample from a surgical standpoint. The surgeon who routinely does a thigh amputation for every case of toe gangrene in diabetes, may well profit by the chapter on gangrene of the lower extremities.

The authors have not made the mistake of writing either a complete monograph on diabetes, or a voluminous surgical text. This volume will appeal to all who read it as a thorough and intelligent *arbeit*. J. R. BUCHBINDER.

THE book on *Surgical Nursing*[3] by Ralph Colp and Manelva Wylie Keller is a very able and interesting treatise on this important branch of medical science. The authors have given the work the stamp of actual experience. Here are found not the imaginings of an observer but the real knowledge of the worker. It carries conviction and is practical. The style is clear and unadorned but the "Introduction and History" cannot be read, even by those to whom the facts have been familiar for years, without real enjoyment and interest.

The subject matter generously includes everything which in any way is related to surgery, even a chapter on radium and X-ray. The chapter on pathology is very good but it must be borne in mind that microscopic drawings have little significance for anyone not experienced in interpreting microscopic sections. The objection is obviated somewhat by the fact that large, clear, well labelled drawings have been used. The chapters dealing with the operating room have the virtue of being practical and generally applicable; the text is splendid and one feels that the writer speaks with authority. The subject of bandaging is handled well, the illustrations are clear and simple, and the account very easy to follow. The chapter on the Carrel-Dakin treatment of wounds merits special mention.

The second edition shows several changes and brings the book up to date in the light of recent developments in surgery and surgical nursing. The arrangement of the subject matter in general is better, topic heads appear in large type with adequate spacing, subtopics are in heavy type.

As a textbook for student nurses, the work has accuracy, completeness, and simplicity of style to recommend it. It should prove useful also as a book of reference for the surgical supervisor and the private duty nurse. NELLIE D. MILLARD.

DISEASES of the nose, throat, and ear are ably covered in the book edited by Chevalier Jackson and George Morrison Coates.[4] The first section

[1] THE PRINCIPLES OF CLINICAL PATHOLOGY IN PRACTICE; A GUIDE TO THE INTERPRETATION OF LABORATORY INVESTIGATION FOR THE USE OF THOSE ENGAGED IN THE PRACTICE OF MEDICINE. By Geoffrey Bourne, M.D. (Lond.), M.R.C.P., and Kenneth Stone, M.D. (Oxon.), M.R.C.P. New York and London: Oxford University Press, 1929.

[2] DIABETIC SURGERY. By Leland S. McKittrick, M.D., F.A.C.S., and Howard F. Root, M.D., with foreword by Daniel F. Jones, M.D., and Elliott P. Joslin, M.D. Philadelphia: Lea and Febiger, 1928.

[3] TEXTBOOK OF SURGICAL NURSING. By Ralph Colp, A.B., M.D., F.A.C.S., and Manelva Wylie Keller, B.S., R.N. New York: The Macmillan Company, 1929.

[4] THE NOSE, THROAT, AND EAR AND THEIR DISEASES; IN ORIGINAL CONTRIBUTIONS BY AMERICAN AND EUROPEAN AUTHORS. Edited by Chevalier Jackson, M.D., Sc.D., LL.D., F.A.C.S., and George Morrison Coates, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1929.

of the book deals with the nose and accessory sinuses. The section on anatomy is quite extensive and illustrated with excellent cuts. The authors discuss in like manner the pharynx and nasopharynx, the ear, diseases of the larynx, peroral endoscopy, and finally diseases of the tracheobronchial tree.

Thirty pages of this text are devoted to the revelations of tonsilloscopy, i.e., the diagnosis of diseases of the tonsils and lymphoid structures by means of transillumination. The various instruments used are illustrated and explained. This is more or less new to include in a textbook although tonsilloscopy was described some years ago. Its value is still open to discussion.

One is impressed by the clearness of the section devoted to the inner ear and labyrinth. Here is set down in clear concise form the mechanism of normal and abnormal nystagmus with its clinical interpretation. The author has gone to extremes to make it practical and understandable. This may also be said of the chapter on intracranial complications of otitis media. Differential tables of meningitis, sinus thrombosis, and brain abscess are given. Every known means or method used in arriving at a definite diagnosis is discussed.

A major portion of the work on the larynx is contributed by such an eminent authority as Chevalier Jackson. Most of the illustrations are drawn from life by the author. A full description of the technique of peroral endoscopy is given by the same author and his co-workers. The text is printed on good paper and the type is clear and distinct with suitable captions.

A good many of the contributions are in the form of monographs and some of them have added excellent bibliographies which would make the book desirable for the research worker as well as for the practitioner. The book is in reality an encyclopædia of diseases of the ear, nose, and throat.

JOHN F. DELPH.

AS in many other instances Friedenwald's *Pathology of the Eye*[1] is founded on a course of lectures given to medical students and house physicians. The author has attempted to show the similarity between ocular pathology and disease of other organs, emphasizing etiology and pathogenesis.

The 330 pages are divided into fifteen chapters with an appendix on microscopic technique. The work is profusely illustrated, mainly with photomicrographs from the pathological collections of the Wilmer Ophthalmological Institute and the Army Medical Museum. At the end of each chapter is a list of references covering the subject matter of that chapter.

Among the original observations and deductions, unpublished elsewhere, is the discussion of subacute panophthalmitis, of ocular lesions in fetal syphilis, of cataract and glaucoma, and of retinal vascular disease. Also the results of experimental researches on the rate of secretion of the aqueous, on the pathogenesis of wood alcohol blindness, and on the relation between cataract and vitamin deficiency are published here for the first time.

No other American author has attempted to present a book on ocular pathology, and few books have been written by the English writers. Friedenwald deserves great credit for presenting this material in such an acceptable manner. VIRGIL WESCOTT.

ARTHRITIS is as old as the oldest fossil and has made miserable the life of man for as long as records are extant. Less real intensive study, however, has been directed toward the elucidation of this problem than toward many less serious and less important. Cecil[2] in his recent monograph on the diagnosis and treatment of arthritis presents a logical classification and a remarkably clear picture of the various arthritides. The crux of any discussion of arthritis is the differentiation of the chronic atrophic and hypertrophic types. While the clinical and pathological pictures are excellently presented by the author, it is doubtful if everyone will accept in their entirety his conclusions as to the etiology of the atrophic type, which he calls the chronic infectious arthritis. While the importance of focal infection is everywhere admitted, it is being pretty strongly felt that the basic causes go back to the individual constitution. It is certain, however, that Cecil's book simplifies the subject of arthritis in a remarkable manner; he leaves one with a very definite and workable conception, not only of the present status of ideas regarding arthritis but of the problems involved and lines of investigation. Each chapter takes up a separate entity, the stress being laid on diagnosis and treatment. The book represents the work being carried on at the Cornell Clinic.

M. L. MASON.

THE second edition of McPheeters' monograph on the injection treatment of varicose veins[3] followed the first in rapid succession, indicating the great demand for knowledge on this subject. A welcome chapter has been added on the Trendelenburg test and its modifications. The author has been largely instrumental in popularizing the injection treatment in this country and gives due credit to Continental workers. Other methods of treatment, such as the radical excision and the combination of ligation with injections are not favored. While the recurrences following radical excision are discussed, no statement is made regarding the end-results of injection treatment.

The printing and illustrations are excellent. It is unfortunate that misspelt references, together with a certain laxity in the construction of the text, deduct somewhat from the inherent value of the material.

GEZA DE TAKATS.

[1] THE PATHOLOGY OF THE EYE. By Jonas Friedenwald, A.M., M.D., F.A.C.S. New York: The Macmillan Company, 1929.

[2] OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT. Edited by Henry A. Christian, M.D., Sc.D., LL.D. Vol. VI.—The Diagnosis and Treatment of Arthritis. By Russell L. Cecil, M.D., Sc.D. New York: Oxford University Press, 1929.

[3] VARICOSE VEINS; WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT. By H. O. McPheeters, M.D., F.A.C.S. Philadelphia: F. A. Davis Company, 1930.

THE recent work by Souttar[1] has been read with considerable interest. The author states in the preface: "Surgery is essentially an Art for it demands of those who would pursue it a combined dexterity of hand and eye, and an instinctive perception of values, which are the characteristics of the true artist. Yet its practice rests upon a mass of knowledge, the accumulated experience of generations, which is apt to overwhelm the student by its mere bulk and to obscure his vision of the whole in a mist of detail. To lighten his burden is the object of this volume, by omitting what is not essential and by describing very fully what is fundamental." This seems adequately to describe the text. In approximately 600 pages the author attempts to separate the wheat from the chaff, a task next to impossible so far as the subject of general and special surgery is concerned. So much depends upon the viewpoint and personal experiences.

The author attempts to illustrate the text to a considerable extent by thumb nail sketches and captions. There is no question but that this aids materially to clarify the text and to simplify finding captions; on the other hand much paper space is lost, thus increasing the bulk of the volume. Many beautiful full page illustrations are in color, which makes the book very attractive. The ones incorporated in this volume are unusually well done.

Souttar's work may be recommended to the college student of surgery but it must be supplemented by extensive collateral reading. JOHN A. WOLFER.

A TREATISE on *Stone and Calculus Disease of the Urinary Organs*[2] has recently been published by J. Swift Joly, surgeon to St. Peter's Hospital for Stone, London. The work is based on a study of some 636 cases of urinary calculi, covering the period from 1915 to 1924. It contains a history of urinary lithiasis and its treatment from the sixth century to the present time.

Probably the most valuable section of this work is that in which the various physical and chemical factors of the formation of stones are discussed. It is held that all calculi are formed of two distinct types of substances; the crystalline and the colloid. The author enters into a very scholarly and academic discussion of the chemistry and physiology of each crystalloid. The formation of calculi he contends is based on retention of crystals as a potential nucleus in a portion of the urinary tract such as the lower kidney calyx.

It is stated that geographical distribution, climate, race, and heredity have no influence or importance in the etiology of stone. Lack of vitamines may play a rôle. The higher the standard of living the fewer the stones found.

Joly has discarded the phenolsulphonephthalein function test for indigocarmine because he is color blind and there is a leakage around catheters and he can eliminate catheterization for determining function.

The most conservative treatment of renal calculus is an early removal of the stone. He discusses at length the medical treatment of various stones and mentions many small points of surgical procedures worthy of note. The book contains many clear cut illustrations of operative procedures and pathological specimens. It embodies sane ideas and I believe it should be in the library of every urologist.

HARRY CULVER.

A MEMORIAL volume,[3] composed of contributions by his numerous pupils, colleagues, and admirers, is a fitting and gracious compliment to the character, talent, and accomplishments of Jean Verhoogen. The occasion is Verhoogen's retirement from the University and L'hôpital Saint-Jean. According to the appended biographical sketch Verhoogen at 65 is still the incontested père of Belgian surgery. His most important contributions are in the field of urologic surgery. He appears to have popularized in Belgium cystoscopy, as well as the operations for the removal of the prostate and nephrectomy. He was able in 1901 to show a patient alive 9 years after a nephrectomy for renal tuberculosis. In 1909 he read a paper on total cystectomy. He was also one of the very first to perform a total gastrectomy (1898), and a lobectomy for pulmonary tuberculosis (1912). The volume contains 747 pages. The greater number of contributions have naturally come from urologists; in fact, it is a veritable textbook on urology. Among the many valuable contributions, it is pleasant to note two from American surgeons: Edward Beer and E. L. Keyes. The subject matter is quite varied and presents much of interest and value.

GEORGE HALPERIN.

[1] THE ART OF SURGERY. By H. S. Souttar, D.M., M.Ch. (Oxon.), F.R.C.S. (Eng.). New York: Paul B. Hoeber, Inc., 1929.

[2] STONE AND CALCULUS DISEASE OF THE URINARY ORGANS. By J. Swift Joly, M.D. (Dub.), F.R.C.S. (Eng.). St. Louis: The C. V. Mosby Company, 1929.

[3] LIVRE JUBILAIRE PUBLIÉ EN L'HONNEUR DU PROFESSEUR JEAN VERHOOGEN. Brussels, 1919.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

BOLETIN ANUAL DE LA CLINICA OBSTETRICA. Universidad de Chile. Prof. Moenckeberg. 1928. (Ano XV).

SURGICAL DIAGNOSIS. By American Authors. Edited by Evarts Ambrose Graham, A.B., M.D. Vols. i and ii. Philadelphia and London: W. B. Saunders Company, 1930.

APPLIED PHYSIOLOGY. By Samson Wright, M.D., M.R.C.P. With Introduction by Swale Vincent, M.D., LL.D., D.Sc., F.R.S. (Ed. & Canada). 3d ed. New York and London: Oxford University Press, 1929.

RADIUM IN GENERAL PRACTICE. By A. James Larkin, B.Sc., M.D. New York: Paul B. Hoeber, Inc., 1929.

LA PRATIQUE CHIRURGICALE ILLUSTRÉE. By Victor Pauchet. Vol. xv. Paris: Gaston Doin et Cie, 1930.

CLINIQUE ET THÉRAPEUTIQUE CHIRURGICALES; PRATIQUE JOURNALIÉRE. By George Pascalis. Paris: Gaston Doin et Cie, 1930.

THE IMPROVED PROPHYLACTIC METHOD IN THE TREATMENT OF ECLAMPSIA. By Prof. W. Stroganoff. 3d ed. rev. Edinburgh: E. & S. Livingstone, 1930.

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OXFORD MONOGRAPHS ON DIAGNOSIS AND TREATMENT. Edited by Henry A. Christian, M.D., Sc.D., LL.D. Vol. vii—The Diagnosis and Treatment of Variations in Blood Pressure and Nephritis. By Herman O. Mosenthal, M.D. Vol. viii—The Diagnosis and Treatment of Diseases of the Liver and Biliary Tract. By John Philipps, M.B. Vol. ix—The Diagnosis and Treatment of Diseases of the Blood. By Thomas Ordway, M.D., and L. Whittington Gorham, M.D. New York: Oxford University Press, 1930.

VARICOSE VEINS; WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT. By H. O. McPheeters, M.D., F.A.C.S. 2d rev. ed. Philadelphia: F. A. Davis Co., 1930.

TRAUMA, DISEASE, COMPENSATION; A HANDBOOK OF THEIR MEDICO-LEGAL RELATIONS. By A. J. Fraser, M.D. Philadelphia: F. A. Davis Company, 1930.

MODERN OTOLOGY. By Joseph Clarence Keeler, M.D., F.A.C.S. Philadelphia: F.A. Davis Company, 1930.

MINOR SURGERY. By Arthur E. Hertzler, M.D., and Victor E. Chesky, M.D. 2d ed. St. Louis: The C. V. Mosby Company, 1930.

DIE THERAPIE AN DEN WIENER KLINIKEN. By Dr. Ernst Landesmann. 11th rev. ed. edited by Prof. Dr. Froehlich. Leipzig and Vienna: Franz Deuticke, 1930.

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A SHORTER SURGERY; A PRACTICAL MANUAL FOR SENIOR STUDENTS. By R. J. McNeill Love, M.B., M.S. (Lond.), F.R.C.S. (Eng.). 2d ed. New York: William Wood & Company, 1930.

THE DRAMATIC IN SURGERY. By Gordon Gordon-Taylor, O.B.E., M.A., F.R.C.S. New York: William Wood and Company, 1930.

THE IMPROVED PROPHYLACTIC METHOD IN THE TREATMENT OF ECLAMPSIA. By Prof. W. Stroganoff. 3d ed., rev.; 1st Eng. ed. New York: William Wood & Co., 1930.

VEIT'S HANDBUCH DER GYNAEKOLOGIE. 3d rev. enlarged ed. Edited by W. Stoeckel and collaborators. First half, Vol. vi. Anatomie und Diagnostik der Carcinome, der Bindegewebsgeschwuelste und Mischgeschwuelste des Uterus, der Blasenmole und des Chorionepithelioma malignum. By Otto von Franqué, H. Hinselmann, and Robert Meyer. Munich: J. F. Bergmann, 1930.

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UTERINE TUMORS. By Charles C. Norris, M.D. New York and London: Harper & Brothers, 1930.

CANCER OF THE BREAST. By William Crawford White, M.D., F.A.C.S. New York and London: Harper & Brothers, 1930.

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GYNECOLOGY FOR NURSES. By George Gellhorn, M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1930.

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RECENT ADVANCES IN NEUROLOGY. By W. Russell Brain, M.A., D.M. (Oxon.), M.R.C.P. (Lond.), and E. B. Strauss, B.A., B.M., B.Ch. (Oxon.), M.R.C.P. (Lond.). 2d ed. Philadelphia: P. Blakiston's Son & Co., Inc., 1930.

O QUE TODOS DEVEM SABER DE CANCRO. Lisbon: Portugues Institute for the Study of Cancer.

AMERICAN COLLEGE OF SURGEONS

THE STANDARDIZATION OF SURGICAL DRESSINGS

MALCOLM T. MacEACHERN, M.D., C.M., D.Sc., CHICAGO
Associate Director, American College of Surgeons, and Director of Hospital Activities

AN extensive survey of the hospital field and a subsequent exhaustive study made by the Hospital Research and Information Department of the American College of Surgeons in co-operation with surgeons, hospital executives, manufacturers, and scientific laboratories, revealed such diversity of surgical dressings that it was considered advisable to undertake the standardization of these with a view to efficiency and economy. A tentative list of standardized dressings for adoption by surgeons and hospitals is presented in this report.

Early in the survey convincing evidence of the need for standardization of surgical dressings was apparent when it was found that approximately five thousand different types of dressings were in use in the five hundred institutions being studied and that as many as fifteen hundred varieties of one type of dressing were used for the same purpose. It was found not only that hospitals located in the same community frequently used entirely different types of dressings for similar work, but that a single hospital, for instance, often carried three or four types of sponges, all for the same purpose but made necessary by special preference of the surgeons or specialists.

Throughout the study it has been constantly kept in mind that surgical dressings are part of the surgeon's armamentarium, and consequently, in compiling a list of standardized dressings, primary consideration has been given to determining sizes and types that will best meet the needs of sound surgical and obstetrical practice. The second purpose or objective of the survey and study has been to design such dressings with a view to reducing costs. The work, therefore, has been based on efficiency and economy in the making up and use of surgical dressings.

Materials used in making dressings vary considerably. Three are recommended. Gauze is the most widely used material but, for the sake of economy and without defeating desired results, cotton may be employed as a dressing if placed between a few layers of gauze. Cellulose wadding is recommended as an inexpensive substitute for cotton in articles—particularly drainage pads—requiring great absorptive power and less tensile strength.

At the outset of the study a definite classification of surgical dressings and nomenclature was adopted. All surgical dressings used may now be included under one of the seven classifications:

I. Sponges—sterile dressings for sponging or wiping.

II. Abdominal packs—sterile dressings for walling off.

III. Sterile gauze dressings—sterile gauze dressings to cover incision after operation.

IV. Pads—sterile dressings to absorb drainage after operation.

V. Gauze drains or tampons—sterile dressings to serve as wicks to draw blood, pus, or other fluids out of wounds to the surface.

VI. Bandages—to hold dressings in place or to provide slight pressure or support.

VII. Binders—to provide pressure or support and hold dressings in place.

Standards are submitted for the first four classes: sponges, abdominal packs, sterile gauze dressings, and pads. It is planned to include in a later report recommendations for the three other classes: gauze drains or tampons, bandages, and binders, as well as special dressings. The proposed standardized dressings are as follows:

Class I—Sponges

1. Large sponge (8x4 in.)—20x12 gauze cut 24x18 in., folded to approximately 8x4½ in., 12 ply.
2. Medium sponge (3x3in.)—20x12 gauze cut 12x12 in., folded to approximately 3½x3 in., 12 ply.
3. Small sponge (2x2 in.)—20x12 gauze cut 6x6 in., folded to approximately 1¾x1½ in., 12 ply.
4. Pointed sponge (6x5 in.)—20x12 gauze cut 18x12 in., folded to five-corner shape, approximately 6½x4¾ in. The ply varies in different parts of the sponge.
5. Tonsil sponge—20x12 gauze cut 6x6 in., folded pouch style to approximately 2x1 in.

Class II—Abdominal packs

6. Large oblong pack—20x16 gauze, dimensions 36x8 in., 8 ply with tape.

7. Medium oblong pack—20x16 gauze, dimensions 18x4 in., 8 ply with tape.
8. Small oblong pack—20x16 gauze, dimensions 12x2 in., 8 ply with tape.
9. Large square pack—20x16 gauze, dimensions 12x12 in., 8 ply with tape.
10. Medium square pack—20x16 gauze, dimensions 8x8 in., 8 ply with tape.
11. Small square pack—20x16 gauze, dimensions 4x4 in., 8 ply with tape.
12. Large roll pack—20x16 gauze, folded to approximately 4 in. x 3 yards, 8 ply.
13. Medium roll pack—20x16 gauze, folded to approximately 2 in. x 2 yards, 8 ply.
14. Small roll pack—20x16 gauze, folded to approximately 1 in. x 1½ yards, 8 ply.

Class III—Sterile gauze dressings

15. Large fluff—20x12 gauze, cut 18x18 in., fluffed.
16. Small fluff—20x12 gauze, cut 12x12 in., fluffed.
17. Large flat—20x12 gauze, folded to 4½x18 in., 8 ply.
18. Small flat—20x12 gauze, cut 36x12 in., folded to 4½x12 in., 8 ply.

Class IV—Pads

19. Large dressing pad—dimensions 12x16 in. Cotton or cellucotton filler with covering of 20x12 gauze.
20. Small dressing pad—dimensions 8x8 in. Cotton or cellucotton filler with covering of 20x12 gauze.
21. Maternity pad—over-all dimensions 22x3½ in. Cotton or cellucotton filler 9¾ in. long, with covering of 20x12 gauze.

The complete report contains full details as to the making up of each of the types mentioned.

The surgeon's time can be saved still further and a more uniform technique may be obtained if specific uses be determined for each of the several dressings specified. It is, therefore, suggested that each hospital put into practical use the dressings recommended and that the staff appoint a surgical technique committee to make a careful study to determine the particular type of dressing best suited for a given operation. This further determination would enable the surgeon to select in an instant the particular dressing required.

The survey and study included the practices in vogue in regard to sponge count, sterilization methods, storage and distribution, and manufacture and reclamation of dressings. The details of these various phases may be found in the complete report as published in the June, 1930, *Bulletin* of the American College of Surgeons. It is believed, however, that all surgeons will be particularly interested in the last two phases, namely, manufacture and reclamation of dressings.

The survey revealed not only the practice in some institutions of reclaiming surgical dressings, but as well the need for a uniform, safe, and reliable method of doing this work. No recommendations have as yet been made as to the advisability of reclaiming surgical dressings, but when this practice is followed, the following recommendations are suggested:

1. Discard all materials contaminated with virulent organisms such as tetanus or gas bacillus and all material stained with iodine, scharlach r, or other stains and dyes.
2. Handle separately all dressings to be reclaimed—(a) segregate in special containers the dressings to be reclaimed; (b) keep the dressings separate from other laundry material by placing them in cord or mesh bags which should be only partially filled and loosely packed; (c) cleanse these bags of dressings apart from other laundry material.
3. Remove gross débris by preliminary soaking.
4. Rinse to secure gross cleanliness.
5. Boil and bleach at 140 to 150 degrees Fahrenheit.
6. Recondition by stretching while moist; dry, and make into packages.
7. Sterilize at least twice on successive days.
8. Put in proper place ready for use.

After reclamation the material in the dressings should approach its original state with threads intact and mesh preserved. Loose or broken fibers render the gauze unfit for use except as a filler or for special purposes. The reclaimed dressings must be free from stains, odors, and extraneous material, and must be as sterile as new dressings. Proper sterilization calls for cultural tests and where this is not possible the reclaimed gauze should be used only in the secondary line of defense, for instance, as a superimposed dressing over new gauze or as an absorptive filler. Before final recommendations for adoption or rejection of the practice are offered, it is desirable that surgeons and hospital executives report their findings as to the value of reclaiming dressings.

Another fact brought out in the study was the growing tendency in hospitals toward the use of ready made dressings. In view of the large number of dressings used annually, it is evident that considerable manual labor is expended in the hospital in the preparation of dressings. In the past much of this work has been done by nurses in training. More recently, however, it has seemed best that for the better care of the patient and for the better education of the nurse, the nurse should be relieved of such menial and unprofessional duties as could be performed by unskilled help or by machines, and the preparation of dressings comes in this category. Such work does not contribute to the nurse's efficiency in caring for the patient and, too, if she is relieved of this task, time is thus saved that she could use to better advantage. In a number of hospitals paid employees make dressings, but here, too, there are objections, principally because of the great amount of time and material wasted, for dressings thus prepared are frequently so lacking in uniformity as to be unfit for use. The utilization of convalescent patients or inmates of charitable organizations for the preparation of

dressings is likewise not desirable because such sources of supply are irregular and result in waste of materials. While ready made dressings will be uniform in size and quality and will effect a saving of hospital employees' time, they are an advantage only if their cost is not too high. A comparison of the costs of ready made and hand made dressings however, should include a consideration of the true cost of hand made dressings, for example, the cost of materials, the salary of the nurse, the cost of maintenance and training of the student nurse, and especially the improvement to be obtained in the nursing service by freeing the nursing staff from the duty of making dressings. Detailed time-labor studies of this problem undertaken by hospitals will aid in drawing future conclusions as to the advisability of ready made dressings.

The standardization and simplification of some of the thousands of dressings now in use have been undertaken in the belief that several distinct advantages would accrue to surgeons and hospitals. In the first place standardization will make for uniformity of practice among hospitals of a given community. This is particularly desirable since many surgeons operate in more than one hospital and do work in a number of institutions in the course of a year, and under present conditions the surgeon is very probably given a different set of dressings in each hospital. This necessitates constant readjustment on the part of both surgeon and nurse, which is neither pleasing to the individual nor does it make for efficiency. Maximum efficiency can be secured only if the same technique can be carried out time after time without change—a strong argument in favor of the standardization of dressings.

Standardization will eliminate much of the present waste which results from a hospital making up and carrying several different sizes and shapes of the same type of dressing to meet the preference of each individual surgeon on the staff. This practice is not only wasteful but it appears that proportionate benefits are not obtained by the surgeon nor is better care secured for the patient. It is believed that the dressings proposed will suffice for most of the requirements of any surgeon and will eliminate the necessity for carrying different types of the same dressing.

The proposed standardized dressings should prove decidedly economical as each has been designed to give the required size and bulk with the minimum amount of material. Each will do the task intended, yet none is larger than necessary for good results. The sizes are such that they can be cut without waste from standard sized packages of gauze, cotton, and cellulose.

One great advantage of standardization is that it will permit the manufacturer to produce ready made surgical dressings much more cheaply. With the present diversity of sizes, the manufacturer sells so few of each dressing that they cannot be produced at low cost. Standardization will encourage quantity production with its consequent economies.

While the proposed dressings are submitted not with the idea of establishing final standards at the outset, it is hoped that they will be put to practical use. As the simplification of dressings concerns both the surgeons and the hospital management, it is essential that the standards be accepted by both in order to secure the best results. It is therefore urged that both the surgical staff and administrative heads of each institution work together in testing out the recommendations made. The ultimate results of proper standardization of surgical dressings, if put into practice by these two bodies, will mean greater convenience to all, a more uniform surgical technique, better utilization of the nurse's time, a saving in time and materials, and a reduction in the cost of dressings.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

MERRITTE W. IRELAND, Washington, *President* C. JEFF MILLER, New Orleans, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

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PRELIMINARY PROGRAM FOR THE 1930 CLINICAL CONGRESS

THE Committee on Arrangements for the twentieth annual Clinical Congress of the American College of Surgeons, to be held in Philadelphia, October 13–17, has prepared a preliminary program or outline of the clinics and demonstrations to be given in the hospitals and medical schools of that city as published in the following pages. The program is to be further revised and amplified during the weeks preceding the Congress in order to present a more complete outline of the clinical work that will be demonstrated. The surgeons of Philadelphia are keenly interested to provide for the visiting surgeons a complete showing of the clinical surgical activities of that great medical center, to include all branches of surgery—general surgery, gynecology, obstetrics, orthopedics, urology, and surgery of the eye, ear, nose, and throat. It will be noted that clinics are scheduled for Monday afternoon beginning at 2 o'clock and for the mornings and afternoons of the following four days.

The real program of the Congress will be issued daily in the form of bulletins that will give a complete, accurate, detailed schedule of the clinics to be given at each of the hospitals. These bulletins, to be posted at headquarters each afternoon, will present the clinical schedules for the following day. Printed bulletins containing the same schedules will be distributed each morning.

Since the last Clinical Congress in Philadelphia, in 1925, a number of new hospitals have been built and some of the older institutions remodeled and enlarged so that in keeping with the growth of the city its clinical facilities have been largely increased.

A special feature of the clinical program will be a series of fracture clinics demonstrating modern methods in the treatment of fractures. Plans are being made by the committee for a comprehensive showing at several of the larger hospitals of methods employed and results obtained in the treatment of fractures, which forms so large a part of surgical work in industrial centers and large cities.

Clinical demonstrations in ophthalmology and otolaryngology will be held at headquarters each morning except Monday, in view of the fact that the clinical work in these specialties will be presented at the hospitals in the afternoons. An attractive program, which will include demonstrations by a number of outstanding American surgeons recognized as leaders in these specialties, is being arranged by a sub-committee headed by Dr. William T. Shoemaker, chairman, and will be published in an early issue of this journal.

Exhibitions of surgical films will be conducted at headquarters twice daily except on Monday. At these exhibitions the motion pictures that have been produced under the supervision of or approved by the Board on Medical Motion Pictures will be exhibited. A number of films will be given their premier showing in Philadelphia. The program will include other outstanding contributions not comprised in the College library of films.

Under the auspices of the Committee on the Treatment of Malignant Diseases a round table conference on the subject of cancer clinics, cancer

hospitals and cancer institutes will be held on Thursday morning at which plans for the organization and administration of such institutions will be discussed. Following the annual meeting on Thursday afternoon there will be presented a symposium on cancer dealing with the scientific aspects of this important problem.

A conference on traumatic surgery is being arranged for Friday, with sessions both morning and afternoon, at which leaders in industry, education and labor, together with representatives of indemnity companies, surgeons and hospital administrators will discuss various phases of this important activity of the College. Dr. Frederic A. Besley, Chairman of the Committee on Traumatic Surgery, will report on the work of the committee in recent years, outlining its present and future activities. The program will include an open forum for the discussion of the many problems involved and the presentation of formal papers by outstanding men.

The annual meeting of the College will be held on Thursday afternoon beginning at 2 o'clock at which time formal reports on the activities of the College by the officers and several standing committees will be presented. Immediately following the annual meeting there will be presented a symposium on cancer.

The Executive Committee has under consideration certain plans for the entertainment of visiting ladies which will include visits to some of the important historic points in and around Philadelphia.

General headquarters for the Clinical Congress will be established at the Bellevue-Stratford Hotel located at the corner of Broad and Walnut Streets. All of the rooms on the second floor, including the grand ballroom which will be used for the evening scientific meetings, hospital conference on Monday, the annual meeting and other large gatherings, together with additional rooms on the roof, have been reserved for the use of the Congress and will be utilized for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc.

EVENING MEETINGS

Programs for a series of five evening meetings are being prepared by the Executive Committee of the Congress. At the Presidential Meeting on Monday evening, following the introduction of distinguished guests from abroad and the inaugural address of the president-elect, Dr. C. Jeff Miller of New Orleans, the Murphy oration in surgery will be delivered by Professor George Grey Turner, Newcastle-on-Tyne, England, professor of surgery, University of Durham, and Hunterian professor and member of council, Royal College of Surgeons of England. Other distinguished visitors from abroad who will present scientific papers at the evening meetings include William Ernest Miles, F.R.C.S., surgeon to the Gordon Hospital for Rectal Diseases and the Cancer Hospital of London, who will present a paper on "Cancer of the Rectum"; Professor Otfried Foerster, of the University at Breslau, Germany, who will discuss the surgical treatment of neurogenic contractures; Professor Emile de Grosz, of Budapest, Hungary, who will present a paper on ophthalmological surgery.

Three major subjects for consideration at the evening meetings will be plastic surgery, including the treatment of burns, injuries, contractures and congenital deformities; surgery of the kidneys, bladder and ureter; and thoracic surgery. Eminent surgeons of the United States and Canada have been invited to present papers dealing with various phases of these subjects.

The annual Convocation of the College, at which the 1930 class of candidates for Fellowship in the College will be received, will be held on Friday evening.

HOSPITAL STANDARDIZATION CONFERENCE

An interesting program of papers, round table conferences and practical demonstrations that deal with problems related to the hospital standardization program of the College and to hospital efficiency in general is being prepared for the thirteenth annual conference, which opens at 9:30 o'clock on Monday morning in the grand ballroom of the Bellevue-Stratford Hotel. A preliminary program follows:

Monday, 9:30–12:00

Opening Address. Major-General MERRITTE W. IRELAND, Washington; President, American College of Surgeons.

Presentation of the Thirteenth Annual Report of Hospital Standardization. FRANKLIN H. MARTIN, M.D., Chicago; Director General, American College of Surgeons.

Our Responsibility as Fellows of the College in Furthering the Hospital Standardization Movement. C. JEFF MILLER, M.D., New Orleans; President-Elect, American College of Surgeons.

What the Hospital Standardization Movement Means to the Present Day Practice of Medicine. GEORGE W. CRILE, M.D., Cleveland; Director, Cleveland Clinic.

My Conception of an Ideal Hospital. Rev. ALPHONSE M. SCHWITALLA, St. Louis; Dean, St. Louis University School of Medicine; President, Catholic Hospital Association.

Is Standardization of Hospital Surgical Procedures Possible? JOSEPH C. DOANE, M.D., Philadelphia; Director, Jewish Hospital.

Monday, 2:00–5:00

FRANK D. JENNINGS, M.D., Brooklyn; Clinical Professor of Surgery, Long Island College Hospital; Surgeon, St. Catherine's Hospital, presiding.

A Study of Acute Appendicitis at St. Catherine's and Greenpoint Hospitals, Brooklyn, from 1919 to 1929 inclusive, for the Purpose of Evaluating the Benefit of Staff Conferences. JOSEPH S. BALDWIN, M.D., Attending Surgeon, Greenpoint and Holy Family Hospitals; HARRY FELDMAN, M.D., Associate Surgeon, Greenpoint Hospital; JOHN A. MCCABE, M.D., Assistant Surgeon, Greenpoint and St. Catherine's Hospitals; JOSEPH L. PFEIFER, M.D., Assistant Surgeon, St. Catherine's Hospital; WALTER J. O'CONNELL, M.D., Assistant Surgeon, St. Catherine's Hospital.

Co-ordination and Integration of the Gynecological-Obstetrical Service in a General Hospital. CHARLES A. GORDON, M.D., Brooklyn; Clinical Professor of Obstetrics and Gynecology, Long Island College Hospital; Attending Obstetrician and Gynecologist, Greenpoint and St. Catherine's Hospitals.

A Plan for the Organization and Control of the Courtesy Staff in a General Hospital. JOHN M. SCANNELL, M.D., Jamaica, N. Y.; Attending Surgeon, St. Catherine's Hospital, Brooklyn; Attending Surgeon, Mary Immaculate Hospital, Jamaica.

The Liaison Committee—a Means of Promoting Co-operation Between the Medical Staff and the Hospital Management. J. GARLAND SHERRILL, M.D., Louisville; Visiting Surgeon, Louisville Public, Jewish, and St. Mary and St. Elizabeth Hospitals.

Is the Private Patient Getting a Square Deal? JOHN E. JENNINGS, M.D., Surgeon-in-Chief, Cumberland Hospital; Surgeon, Brooklyn and St. Peter's Hospitals.

Tuesday, 9:30–12:30

Important Basic Considerations in Maintaining an Adequate X-Ray Service in Various Sized Hospitals. EDWARD S. BLAINE, M.D., Chicago; Radiologist, Wesley Memorial Hospital.

Autopsies, Their Value and Certain Factors that Will Influence Their Increase. B. HENRY MASON, M.D., Waterbury, Conn.; Superintendent, Waterbury Hospital.

Absorption of Special Charges in Hospitals (illustrated). LAWRENCE C. AUSTIN, Milwaukee; Superintendent, Mount Sinai Hospital.

The Hospital's Teaching Responsibility. JOHN E. RANSOM, Baltimore; Assistant Director, Johns Hopkins Hospital.

Tuesday, 2:00–5:00

Round Table Conference—Functions, Relationships, and Responsibilities of the Board of Trustees, Medical Staff, and Superintendent. Conducted by C. W. MUNGER, M.D., Valhalla, N. Y.; Director, Westchester County Department of Hospitals.

Wednesday, 9:30–12:30

Organization of the Record Department (illustrated). PAUL H. FESLER, Minneapolis; Superintendent, University Hospitals.

Centralization of Medical Statistics in the Record Department. MARY M. NEWTON, R.N., Pittsburgh; Medical Statistician, Pittsburgh Homeopathic Hospital.

Rôle of the Student Nurse in the Clinical Record. MARY MERRILL, Williamsport; Student Nurse, School of Nursing, Williamsport Hospital.

Case Records and Clinical Conferences. IRVIN D. METZGER, M.D., Pittsburgh; President, Pennsylvania State Board of Medical Education and Licensure.

Wednesday, 2:00–5:00

Round Table Conference—Medical and Hospital Economics. Conducted by ROBERT JOLLY, Houston, Texas; Superintendent, Baptist Hospital. Educating the Public; Costs versus Value of Medical and Hospital Services; Medical and Hospital Economics in relation to planning and construction, management, scientific departments (clinical laboratory, X-ray and physical therapy); Standardization of Equipment and Supplies; Group Nursing; Rôle of the Social Worker; Rôle of the Dietitian.

Round table conferences dealing with subjects of interest to hospital trustees, superintendents, nurses and all hospital executives are being planned for Thursday and Friday mornings. The afternoons of those two days will be devoted to visits to hospitals with demonstrations on hospital planning and construction, equipment, management, etc.

An invitation to attend the conference is extended to all persons interested in the hospital field.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Philadelphia session of the Clinical Congress so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to Philadelphia, procuring from the ticket agent when purchasing ticket, a "convention certificate," which certificate is to be deposited at headquarters for the signature of the general manager of the Clinical Congress and the visé of a special agent of the railways. Upon presentation of a viséd certificate to the ticket agent in Philadelphia not later than October 21st a ticket for the return journey by the same route as traveled to Philadelphia may be purchased at one-half the one-way fare.

In the eastern, central and southern states and eastern provinces of Canada tickets may be purchased between October 9th and 15th; in other sections of the United States and Canada at somewhat earlier dates. The return journey from Philadelphia must be begun not later than October 21st.

The reduction in fares does not apply to Pullman fares, nor to extra fares charged for passage on certain trains. Local railroad ticket agents

will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Philadelphia, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséd by a special railroad agent in Philadelphia during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Philadelphia and that the certificate must be deposited at headquarters during the meeting and return ticket purchased and used not later than October 21st.

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to Philadelphia via a direct route and returning via another direct route with liberal stop-over privileges.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Philadelphia session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for acommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets. This plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

PHILADELPHIA HOTELS AND THEIR RATES

There are ample first-class hotel facilities available in Philadelphia for all who will attend, as in recent years a number of fine hotels have been built. Many of the hotels are located within walking distance of the headquarters hotel. The following hotels are recommended by the Committee on Arrangements:

	Minimum Rates with Bath	
	Single Room	Double Room
Adelphia, 13th and Chestnut Sts.	$ 4.00	$ 7.00
Barclay, Rittenhouse Square East	6.00	8.00
Bartram, 33rd and Chestnut Sts.	.....	8.00
Belgravia, 1811 Chestnut St.	4.00	7.00
Bellevue-Stratford, Broad and Walnut	5.00	7.00
Benjamin Franklin, 9th and Chestnut	4.00	7.00
Colonial, 11th and Spruce Sts.	4.00	7.00
Drake, 1512 Spruce St.	5.00	8.00
Elks, Broad and Vine Sts.	2.50	5.00
Gladstone, 11th and Pine Sts.	4.00	7.00
Green's, 8th and Chestnut Sts.	3.00	4.50
Lorraine, Broad and Fairmount Ave.	5.00	9.00
Maidstone, 1327 Spruce St.	3.00	5.00
Majestic, Broad and Girard Ave.	4.00	6.00
Mayfair, Lincoln Drive and Johnson St.	5.00	8.00
Pennsylvania, 39th and Chestnut Sts.	3.00	5.00
Rittenhouse, 22nd and Chestnut Sts.	3.00	5.00
Ritz-Carlton, Broad and Walnut Sts.	6.00	10.00
Robert Morris, 17th and Arch Sts.	3.50	5.00
St. James, 13th and Walnut Sts.	3.50	5.00
Stephen Girard, 2027 Chestnut St.	3.00	5.00
Sylvania, Juniper and Locust Sts.	4.00	8.00
Tracy, 36th above Chestnut St.	3.00	5.00
Walton, Broad and Locust Sts.	3.50	5.00
Warwick, 17th and Locust Sts.	5.00	8.00
Wellington, 19th and Walnut Sts.	5.00	6.00
Westbury, 15th and Spruce Sts.	5.00	10.00

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

LANKENAU HOSPITAL

Monday

JOHN B. DEAVER—12. General surgical clinic.
WILLIAM MACKINNEY—3. Cystoscopy.

Tuesday

STANLEY REIMANN and staff—9. Exhibit of pathological specimens and demonstration of laboratory tests.
DR. HAMMETT—9. Chemistry of cell division.
MRS. MCNETT—9. Exhibition of drawings of pathological specimens.
MISS JASTROW—11. Exhibition of follow-up service.
ROBERT SHOEMAKER—11. X-ray demonstration.

Wednesday

STANLEY REIMANN and staff—9. Exhibit of pathological specimens and demonstration of laboratory tests.
DR. HAMMETT—9. Chemistry of cell division.
MRS. MCNETT—9. Exhibition of drawings of pathological specimens.
COLBY ENGEL—9. Injection treatment of varicose veins.
MISS JASTROW—11. Exhibition of follow-up service.
ROBERT SHOEMAKER—11. X-ray demonstration.
JOHN B. DEAVER—12. General surgical clinic.

Thursday

STANLEY REIMANN and staff—9. Exhibit of pathological specimens and demonstration of laboratory tests.
DR. HAMMETT—9. Chemistry of cell division.
MRS. MCNETT—9. Exhibition of drawings of pathological specimens.
MISS JASTROW—11. Exhibition of follow-up service.
ROBERT SHOEMAKER—11. X-ray demonstration.
JOHN B. DEAVER—12. General surgical clinic.

Friday

COLBY ENGEL—9. Injection treatment of varicose veins.
STANLEY REIMANN and staff—9. Exhibit of pathological specimens and demonstration of laboratory tests.
DR. HAMMETT—9. Chemistry of cell division.
MRS. MCNETT—9. Exhibition of drawings of pathological specimens.
MISS JASTROW—11. Exhibition of follow-up service.
ROBERT SHOEMAKER—11. X-ray demonstration.
WILLIAM MACKINNEY—3. Cystoscopy.

METHODIST EPISCOPAL HOSPITAL

Tuesday

DAMON B. PFEIFFER and CALVIN M. SMITH, JR.—9. General surgical operations.

Wednesday

JOHN C. HIRST and LEONARD HAMBLOCK—9. Operative gynecology and obstetrics.
JAMES H. BALDWIN—9. General surgical operations.

Thursday

GEORGE SCHWARTZ—9. General surgical operations.

Friday

DAMON B. PFEIFFER and CALVIN M. SMYTH, JR.—9. General surgical operations.

UNIVERSITY HOSPITAL

Tuesday

CHARLES C. NORRIS, C. A. BEHNEY and D. P. MURPHY—9. Gynecological operations and demonstration of cases.
DRS. MULLER, OVERHOLT and RADEMAKER—9. Surgical clinic, abdominal cases.
EDMUND B. PIPER and staff—9. Obstetrical operations.
C. H. FRAZIER and F. C. GRANT—9. Neurosurgical clinic.
DRS. MULLER, OVERHOLT and RADEMAKER—2. Dry clinic: Special tests used in the study of vascular disturbances; opaque solutions available in the roentgenological study of surgical patients; factors in the production of chills following intravenous infusions; intraperitoneal and intrapleural pressure relationships; the course of events in acute appendicitis.
I. S. RAVDIN—2. Gall bladder surgery, operations and demonstration of cases.
C. H. FRAZIER and F. C. GRANT—2:30. Neurosurgical clinic, demonstration of interesting cases.

Wednesday

FLOYD E. KEENE and staff—9. Gynecological operations.
E. L. ELIASON and staff—9. General surgical clinic.
F. C. GRANT—9. Neurosurgical clinic.
A. BRUCE GILL and staff—2. Orthopedic surgery, dry clinic with demonstration of end results.

Thursday

C. H. FRAZIER and F. C. GRANT—9. Neurosurgical operations.
DRS. MULLER, OVERHOLT and RADEMAKER—9. Surgical clinic, thoracic cases, operations and demonstration of cases.
EDMUND B. PIPER and staff—9. Obstetrical operations.
DRS. MULLER, OVERHOLT and RADEMAKER—2. Dry clinic: Results in the surgical treatment of lung abscess; methods of treating empyema; presentation of "follow-up" chest cases of lung abscess, bronchiectasis, chronic empyema and pulmonary tuberculosis.
A. BRUCE GILL and staff—2. Orthopedic operations.
B. J. ALPERS—2:30. Neuropathological conference.

Friday

C. H. FRAZIER—9. Neurosurgical clinic.
FLOYD E. KEENE and staff—9. Gynecological operations.
EDMUND B. PIPER—9. Obstetrical operations.
E. L. ELIASON and staff—9. Fracture clinic.

FRANKFORD HOSPITAL

Tuesday

C. F. NASSAU, L. D. ENGLERTH and B. CHANDLEE—9. General surgery.

Wednesday

EDWARD SCHUMANN and FREDERICK KELLER—9. Gynecological clinic.

Thursday

W. E. PARKE—9. Gynecological clinic.
GEORGE HANNA—9. Obstetrical clinic.
L. D. ENGLERTH and B. CHANDLEE—2. Fracture clinic.

JEFFERSON HOSPITAL

Tuesday

P. BROOKE BLAND and staff—9. Gynecology and obstetrics.
J. TORRANCE RUGH and staff—10. Orthopedics.
J. CHALMERS DA COSTA and staff—11. General surgery.
THOMAS C. STELLWAGEN and staff—11. Genito-urinary surgery.
JOHN H. GIBBON and staff—2. General surgery.

Wednesday

BROOKE M. ANSPACH and staff—9. Gynecology.
P. BROOKE BLAND and staff—9. Gynecology and obstetrics.
THOMAS C. STELLWAGEN and staff—11. Genito-urinary surgery.
J. CHALMERS DA COSTA and staff—2. General surgery.

Thursday

P. BROOKE BLAND and staff—9. Gynecology and obstetrics.
THOMAS C. STELLWAGEN and staff—10. Genito-urinary surgery.
J. CHALMERS DA COSTA and staff—11. General surgery.
J. TORRANCE RUGH and staff—11. Orthopedic surgery.
P. BROOKE BLAND and staff—4. Obstetrics.

Friday

BROOKE M. ANSPACH and staff—9. Gynecology.
P. BROOKE BLAND and staff—9. Gynecology and obstetrics.
THOMAS C. STELLWAGEN and staff—11. Genito-urinary surgery.
JOHN H. GIBBON—11. General surgery.

MT. SINAI HOSPITAL

Monday

MOSES BEHREND—1:15. General surgical operations.

Tuesday

BENJAMIN LIPSHUTZ—9. General surgical operations.
ALEXANDER RANDALL—1:30. Urological clinic, operations and demonstration of cases.

Wednesday

CHARLES MAZER—9. Operative gynecology.
MORRIS COOPERMAN—2. Orthopedic clinic, operations and demonstration of cases.

Thursday

BERNARD MANN—9. Operative gynecology.
ALEXANDER RANDALL—1:30. Urological clinic, operations and demonstration of cases.

Friday

BENJAMIN LIPSHUTZ—9. General surgical operations and demonstration of cases.
MOSES BEHREND—1. General surgical operations and demonstration of cases.

WOMAN'S HOMEOPATHIC HOSPITAL

Tuesday

FRANCOIS L. HUGHES—9. Gynecological clinic.

Wednesday

ARTHUR HARTLEY—9. General surgical clinic.

GRADUATE HOSPITAL

Monday

GEORGE E. PFAHLER—2. Radiation in diagnosis of malignant diseases.
GEORGE PIERSOL—2. Dry clinic: Cardiorenal cases.
ORLANDO PETTY—4. Demonstration of diabetes cases.

Tuesday

H. L. BOCKUS—9. Gastro-intestinal diagnosis.
WALTER E. LEE—9. General surgical clinic.
B. A. THOMAS—2. Genito-urinary operations.

Wednesday

JOHN P. JOPSON—9. General surgery.
H. L. BOCKUS—2. Gastro-intestinal diagnosis.
EUGENE A. CASE—2. Surgical pathology.
GEORGE PIERSOL—2. Dry clinic: Cardiorenal cases.

Thursday

EUGENE A. CASE—2. Surgical pathology.
C. F. MARTIN and W. O. HERMANCE—9. Rectal infections.

Friday

J. B. CARNETT—9. General surgical clinic.
B. A. THOMAS—2. Genito-urinary operations.
GEORGE PIERSOL—2. Dry clinic: Cardiorenal cases.
GEORGE E. PFAHLER—2. Radiation in diagnosis and treatment of malignant diseases.

CHESTNUT HILL HOSPITAL

Tuesday

JOHN MCCLOSKEY—10:30. General surgical clinic.
DRS. SCHUMANN, BARRETT and TOWSON—11. Operative obstetrics.

Thursday

CHARLES BEHNEY—9. Operative gynecology.
ALEXANDER RANDALL—9. Urological clinic.

Friday

W. C. SHEEHAN and L. HERGESHEIMER—9. General surgery.
DRS. SCHUMANN, BARRETT and TOWSON—11. Operative obstetrics.

JEANES HOSPITAL

Wednesday

R. W. TEAHAN—2. Carcinoma of breast.
C. A. WHITCOMB—2. Lung tumors.
E. E. DOWNS—2. The saturation method of X-ray treatment.
W. S. HASTINGS—2. Exhibition of interesting pathological specimens.

Thursday

R. W. TEAHAN—2. Carcinoma of skin.
C. A. WHITCOMB—2. Mediastinal masses.
E. E. DOWNS—2. Exhibition of interesting X-ray films.
W. S. HASTINGS—2. Exhibition of interesting pathological specimens.

ST. CHRISTOPHER'S HOSPITAL

Tuesday

Staff—10. General surgery.

Friday

R. L. JOHN—10. Orthopedics.

TEMPLE UNIVERSITY HOSPITAL

Monday

WILLIAM A. STEEL—1. Surgical operations.
W. HERSEY THOMAS—3. Genito-urinary surgery.
TEMPLE FAY—3. Surgical treatment of epilepsy.
EUGENE P. PENDERGRASS—3. Surgical radiologic conference, roentgenologic diagnosis of hypertrophied gastric mucosa and pedunculated tumors of the stomach prolapsing into the duodenum.
FRANK W. KONZELMAN—4. Surgical pathological conference.

Tuesday

TEMPLE FAY—9. Neurosurgical clinic, encephalography.
W. WAYNE BABCOCK—10. General surgical operations.
FRANK C. HAMMOND, H. DUNCAN and C. S. MILLER—11. Operative gynecology.
HARRY HUDSON—1. Orthopedic surgery.
TEMPLE FAY—3. Management of traumatic injuries to the brain.
EUGENE P. PENDERGRASS—3. Surgical radiological conference, roentgenologic diagnosis of liver abscess and subdiaphragmatic collections.
FRANK W. KONZELMAN—4. Surgical pathological conference.

Wednesday

WILLIAM N. PARKINSON—9. General surgical operations.
TEMPLE FAY—9. Neurosurgical clinic, spinal cord tumor cases.
W. WAYNE BABCOCK—10. General surgical operations.
LOUIS COHEN—10. Artificial pneumothorax on ambulant patients.
FRANK C. HAMMOND, H. DUNCAN and C. S. MILLER—12. Operative gynecology.
WILLIAM A. STEEL—1. General surgical operations.
H. Z. HIBSHMAN—3. Atypical neuralgia and trigeminal neuralgia.
EUGENE P. PENDERGRASS—3. Surgical radiological conference, roentgenologic study of the neck and upper respiratory tract.
FRANK W. KONZELMAN—4. Surgical pathological conference.

Thursday

TEMPLE FAY—9. Neurosurgical clinic, cerebellar tumor cases.
W. WAYNE BABCOCK—10. General surgical operations.
FRANK C. HAMMOND, H. DUNCAN and C. S. MILLER—12. Operative gynecology.
WILLIAM A. STEEL—12. Buerger's clinic, operative and ambulant cases.
JESSE ARNOLD—1. Obstetrics.
TEMPLE FAY—3. Neurosurgical clinic, hydration states, normal in eclampsia and uremia, and acute toxic states.
EUGENE P. PENDERGRASS—3. Surgical radiological conference.
FRANK W. KONZELMAN—4. Surgical pathological conference.

Friday

WILLIAM N. PARKINSON—9. General surgical operations.
TEMPLE FAY—9. Neurosurgical clinic, gangliectomy or sympathectomy.
W. WAYNE BABCOCK—10. General surgical operations.
LOUIS COHEN—10. Artificial pneumothorax on ambulant patients.
FRANK C. HAMMOND, H. DUNCAN and C. S. MILLER—12. Operative gynecology.
WILLIAM A. STEEL—1. Operative surgery.
W. HERSEY THOMAS—3. Genito-urinary operations.
TEMPLE FAY—3. Neurosurgical clinic.
EUGENE P. PENDERGRASS—3. Surgical radiological conference, encephalography.
FRANK W. KONZELMAN—4. Surgical pathological conference.

EPISCOPAL HOSPITAL

Monday

H. C. DEAVER—1:30. General surgical clinic.

Tuesday

LOUIS H. MUTSCHLER—11:30. General surgical clinic.
JOHN B. HAINES—2. Urological clinic.
TEMPLE FAY—2. Neurosurgical clinic.

Wednesday

A. P. C. ASHHURST—9. General surgical clinic.
R. L. JOHN—1:30. Orthopedic clinic.
R. S. BROMER—2. X-ray demonstration.

Thursday

ROBERT H. IVY—9. Oral surgery.
E. G. ALEXANDER—9. General surgical clinic.
H. C. DEAVER—1:30. General surgical clinic.

Friday

LOUIS H. MUTSCHLER—11:30. General surgical clinic.
JOHN B. HAINES—2. Urological clinic.

ST. AGNES HOSPITAL

Monday

WILBUR HAINES and F. MICELI—2. Urological clinic.

Tuesday

E. C. MURPHY—9. General surgical clinic.
LEONARD AVERETT—10. Gynecological clinic.

Wednesday

J. W. BRANSFIELD—9. General surgical clinic.
G. M. DORRANCE—2. General surgery and cleft palate clinic.
WILBUR HAINES—2. Urological surgery.

Thursday

J. F. X. JONES—9. General surgical clinic.
JOHN A. MCGLINN—10. Gynecological clinic.
W. W. VAN DOLSEN—11. Obstetrical clinic.

Friday

G. M. DORRANCE—9. General surgical clinic.
WILBUR HAINES and F. MICELI—2. Urological clinic.

PENNSYLVANIA HOSPITAL

Tuesday

CHARLES F. MITCHELL and associates—9. Surgical clinic.

Wednesday

JOHN H. GIBBON and associates—9. Surgical clinic.

Thursday

CHARLES F. MITCHELL and associates—9. Surgical clinic.

Friday

JOHN H. GIBBON and associates—9. Surgical clinic.

HAHNEMANN HOSPITAL

Monday

H. P. LEOPOLD—2. Hernia clinic.
D. B. JAMES and staff—2. Operative gynecology.

Tuesday

A. B. WEBSTER—9. Fracture clinic.
JOHN E. JAMES and staff—2. Obstetrics.
L. T. ASHCRAFT and staff—2. Genito-urinary surgery.

Wednesday

L. T. ASHCRAFT and FRANK BENSON—9. Neoplasms of the genito-urinary tract.
H. L. NORTHROP—2. General surgical clinic.

Thursday

J. DEAN ELLIOTT—9. General surgical clinic.
D. B. JAMES and staff—9. Operative gynecology.
JOHN A. BROOKE and staff—2. Dry clinic, orthopedic surgery.

Friday

H. L. NORTHROP and staff—9. General surgical clinic.
FRANK BENSON—9. Indications for radium treatment.

CHILDREN'S HOSPITAL

WALTER ESTELL LEE. Surgical clinic.
WILLIAM A. JAQUETTE. Dental clinic.
HOWARD CHILDS CARPENTER. Preventive medicine in reference to surgical diseases in children.
SUSAN C. FRANCIS, R. N. Hospital management from surgical viewpoint.
J. C. GITTINGS. Medical aspect of surgical cases in children.
RALPH S. BROMER. Roentgenological aspect of children's diseases.
EDWARD F. CORSON. Bone syphilis and other allied surgical conditions.
C. C. NORRIS. Vaginitis clinic.

ORTHOPEDIC HOSPITAL

Tuesday

A. P. C. ASHHURST, R. L. JOHN and E. T. CROSSAN—1. Out-patient clinic.
A. B. GILL—9. Orthopedic operations.

Thursday

A. P. C. ASHHURST—9. Orthopedic operations.
WILLIAM J. TAYLOR—1. Out-patient clinic.

Friday

WILLIAM J. TAYLOR—1. Orthopedic operations.

WOMAN'S MEDICAL COLLEGE HOSPITAL

Tuesday

HUBLEY R. OWEN—9. General surgery.

Wednesday

MARGARET C. STURGIS—9. Demonstration of the use of carbon dioxide tubal insufflation and uterosalpingograms in the diagnosis of sterility.

Thursday

CATHARINE MACFARLANE—9. Gynecological clinic.

Friday

JOHN S. RODMAN—9. General surgery.

PRESBYTERIAN HOSPITAL

Tuesday

E. B. HODGE and H. P. BROWN—9. General surgery.
A. B. GILL and T. ORR—2. Orthopedics.

Wednesday

D. B. PFEIFFER and J. S. RODMAN—9. General surgery.
B. A. THOMAS, J. C. BIRDSALL and F. G. HARRISON—2. Genito-urinary surgery.

Thursday

J. H. JOPSON and W. E. CHRISTIE—9. General surgical operations.
J. H. GIRVIN, G. M. LAWS and J. P. LEWIS—2. Gynecological operations.

Friday

J. SPEESE and F. A. BOTHE—9. General surgery.

NORTHWESTERN GENERAL HOSPITAL

Monday

J. S. RAUDENBUSH—2. Gynecology.

Tuesday

J. B. MENCKE, ROBERT BOYER and E. B. PARKER—9. General surgical operations.
ARTHUR D. KURTZ—2:30. Orthopedic clinic.

Wednesday

J. B. MENCKE, ROBERT BOYER and E. B. PARKER—9. General surgical operations.
J. S. RAUDENBUSH—12. Gynecology.
E. C. DAVIS—3. Rectal clinic.

Thursday

J. B. MENCKE, ROBERT BOYER and E. B. PARKER—9. General surgical operations.
L. F. MILLIKEN—2:30. Genito-urinary surgery.

NORTHEASTERN HOSPITAL

Tuesday

E. C. DAVIS—2. Proctology.
T. T. THOMAS and J. C. SCOTT—3. Dry clinic, fractures and dislocations.

Wednesday

J. B. LOWNES—4. Genito-urinary surgery.

Thursday

J. S. RAUDENBUSH—2. Gynecology and obstetrics.
T. T. THOMAS—3. General surgery.

U. S. NAVAL HOSPITAL

Tuesday

Staff—9. Surgical operations.

Wednesday

Staff—9. Surgical operations.

Thursday

Staff—9. Surgical operations.

Friday

Staff—2. Discussion of surgical cases or surgical topics.

PHILADELPHIA GENERAL HOSPITAL

Tuesday

M. P. WARMUTH—9. General surgery.
FRANK C. HAMMOND—9. Gynecology and obstetrics.

Wednesday

J. T. RUGH—9. Orthopedics.
HUBLEY OWEN—2. General surgery.

Thursday

JOHN O. BOWER—9. General surgery.
E. A. SCHUMANN—9. Gynecology and obstetrics.
WILLIAM H. MACKINNEY—2. Genito-urinary surgery.

Friday

HARVEY M. RIGHTER—9. General surgery.
Staff—2. X-ray demonstration.

JEWISH HOSPITAL

Tuesday

PHILIP WILLIAMS and E. SCHUMANN—9. Operative gynecology.
RALPH GOLDSMITH—10. Fracture clinic.
WILLIAM H. KELLER—2. General surgical operations.

Wednesday

FRANK B. BLOCK—9. General surgical operations.
MOSES BEHREND—11. General surgical clinic.
THOMAS STELLWAGEN and JOHN B. LOWNES—2. Urological operations.
LEON BRINKMANN—2. General surgical operations.

Thursday

MOSES BEHREND—9. General surgical clinic, moving pictures; gastro-enterological cases.

Friday

PHILIP WILLIAMS and E. SCHUMANN—9. Operative gynecology.
RALPH GOLDSMITH—10. Fracture clinic.
WILLIAM H. KELLER—2. General surgical operations.

ST. MARY'S HOSPITAL

Tuesday

JAMES A. KELLY—9. General surgery.
WILLIAM J. RYAN—9. General surgery.
WILLIAM E. PARKE—1. Obstetrical clinic.

Wednesday

A. P. KEEGAN—9. General surgery.
WILLIAM MORRISON—9. Gynecology.

Thursday

HENRY K. SEELAUS—9. General surgery.
JOSEPH TOLAND—9. Gynecology.
J. STUART LAWRANCE—1. Obstetrical clinic.

Friday

P. A. MCCARTHY—9. General surgery.
LEO WOJCZYNSKI—9. Gynecology.

BABIES HOSPITAL

Tuesday

JOHN SINCLAIR and WILLIAM BATES—2:30. Presentation of follow-up cases of intussusception and congenital hypertrophic stenosis.

Thursday

JOHN SINCLAIR and I. BINDER—2:30. Conservative treatment of cervical adenitis.

MISERICORDIA HOSPITAL

Tuesday

J. A. KELLY and B. R. BELTRAN—9. General surgical operations.
F. MOGAVERO—11. Pre- and postoperative care.

Wednesday

G. P. MULLER and T. RYAN—9. General surgical operations.
DR. DOUGHERTY—11. Fractures of the femur.

Thursday

J. A. KELLY and B. R. BELTRAN—9. General surgical operations.
J. A. SHARKEY and D. C. GEIST—11. Blood transfusion; operative results in fractures.

Friday

G. P. MULLER and T. RYAN—9. General surgical operations.
J. B. CARDONE and E. J. GARVIN—11. General surgical clinic.

STETSON HOSPITAL

Monday

CARL F. KOENIG—1:30. X-ray demonstration.

Tuesday

WILLIAM T. ELLIS and JOHN A. BOGER—12. General surgery.

Wednesday

STEPHEN E. TRACY—8:30. Gynecology.
CARL F. KOENIG—1:30. X-ray demonstration.

Friday

STEPHEN E. TRACY—8:30. Gynecology.
CARL F. KOENIG—1:30. X-ray demonstration.

PENNSYLVANIA HOSPITAL

(Maternity Department and Lying-In Hospital)

Tuesday

N. W. VAUX and staff—9. Obstetrics and gynecology.

Wednesday

E. B. PIPER and staff—9. Obstetrics and gynecology.

Thursday

N. W. VAUX and staff—9. Obstetrics and gynecology.

Friday

E. B. PIPER and staff—9. Obstetrics and gynecology

WOMAN'S SOUTHERN HOMEOPATHIC HOSPITAL

Tuesday

JOHN DEAN ELLIOTT, T. C. GEARY and THOMAS DOYLE—9. General surgical clinic.
LEON T. ASHCRAFT—2. Urological surgery.

Wednesday

JOHN A. BROOKE—2. Orthopedic surgery.

Thursday

NATHANIEL F. LANE—2. Gynecological clinic.
NEWLIN F. PAXSON—2. Lipiodol study of fallopian tubes.

Friday

WARREN C. MERCER—2. Postnatal clinic.

COOPER HOSPITAL

(Camden)

Tuesday

P. M. MECRAY, A. S. ROSS, F. W. SHAFER, and I. E. DEIBERT—9. General surgical operations.
T. B. LEE, A. B. DAVIS, and G. F. WEST—9. Operative gynecology and obstetrics.
I. E. DEIBERT and R. S. GAMON—10. Fracture clinic.

Wednesday

P. M. MECRAY, A. S. ROSS, F. W. SHAFER, and I. E. DEIBERT—9. General surgical operations.
B. F. BUZBY—9. Operative orthopedics.
A. H. LIPPINCOTT and D. F. BENTLEY—2. Urological operations.
P. M. MECRAY, A. S. ROSS, F. W. SHAFER, and I. E. DEIBERT—2. End results in fracture cases.
B. F. BUZBY—3. Demonstration of orthopedic cast and end results.

Thursday

P. M. MECRAY, A. S. ROSS, F. W. SHAFER, and I. E. DEIBERT—9. General surgical operations.
T. B. LEE, A. B. DAVIS, and G. F. WEST—9. Operative gynecology and obstetrics.
A. S. ROSS—2. End results in industrial injuries (New Jersey State Clinic).

Friday

P. M. MECRAY, A. S. ROSS, F. W. SHAFER, and I. E. DEIBERT—9. General surgical operations.
B. F. BUZBY—9. Operative orthopedics.
I. E. DEIBERT and R. S. GAMON—10. Fracture clinic.

ST. JOSEPH'S HOSPITAL

Monday

FRANCIS J. MCCULLOUGH—3. Obstetrical clinic.

Tuesday

MELVIN M. FRANKLIN—9. Fractures in children.
F. HURST MAIER—10. Gynecological operations.

Wednesday

JAMES A. KELLY—9. General surgical clinic.
JOHN F. X. JONES—9. General surgical clinic.

Thursday

ALEXANDER E. BURKE—8. Gynecological surgery.
F. HURST MAIER—10. Gynecological surgery.
CHARLES F. NASSAU—10. General surgery.

Friday

MELVIN M. FRANKLIN—9. Surgery of children.
FRANCIS J. MCCULLOUGH—3. Obstetrical clinic.

EVANS DENTAL INSTITUTE

Tuesday

ROBERT H. IVY—9. Fracture of the jaw.

Wednesday

LAWRENCE CURTIS—9. Oral surgical clinic.

Thursday

ROBERT H. IVY and LAWRENCE CURTIS—9. Oral surgical clinic.

ST. LUKE'S AND CHILDREN'S HOMEOPATHIC HOSPITAL

Tuesday

A. B. WEBSTER—9. Surgical clinic.
WARREN C. MERCER and staff—9. Obstetrical clinic.

Wednesday

HERBERT P. LEOPOLD and staff—9. Surgical clinic.
WILLIAM C. HUNSICKER and staff—9. Urological clinic.

Thursday

H. K. ROESSLER—9. Surgical clinic.
RICHARD W. LARER, JOHN A. BROOKE and staff—9. Orthopedic clinic.
JAMES D. SCHOFIELD and staff—9. Clinic on diseases of the rectum.
WESTON D. BAYLEY and associates—2. Neurosurgical symposium on injuries of the head.
FRANK C. BENSON and staff—2. Dry clinic: Indications and contra-indications for use of radium in myopathic hæmorrhage.
G. MORRIS GOLDEN and group—2. Dry clinic and symposium on pre- and postoperative problems of toxic goiter.

WOMAN'S HOSPITAL

Tuesday

EMILY W. AUGE—9. General surgery.

Wednesday

FAITH S. FETTERMAN—9. Cystoscopic demonstration.

Thursday

LIDA S. COGILL—2. Obstetrical demonstration.

Friday

MARIE FORMAD—9. Gynecological clinic.

KENSINGTON HOSPITAL FOR WOMEN

Tuesday

H. C. DEAVER—12. General surgery.

Wednesday

WILLIAM E. PARKE—10. General surgery.
JOHN B. HAINES—3:30. Cystoscopic clinic.

Friday

H. C. DEAVER—12. General surgery.

GERMANTOWN HOSPITAL

Wednesday

WILLIAM B. SWARTLEY—10. General surgery.

Friday

WILLIAM B. SWARTLEY—10. General surgery.

AMERICAN ONCOLOGIC HOSPITAL

Tuesday

ALBERT E. BOTHE, CHARLES E. CODMAN, GEORGE M. DORRANCE, WILLIAM C. HUEPER, BRADY A. HUGHES, C. B. LONGENECKER, SAMUEL MCCLARY III, ELLICE MCDONALD, WILLIAM S. NEWCOMET, DAMON B. PFEIFFER, WILLIAM D. ROBINSON, JESSE W. SMITH, WILLIAM H. SPENCER and S. E. TRACY—9. Clinical conference with exhibition of patients: Fibroid tumors, breast cases, congenital mouth cases, hemangiomas, etc.

SURGERY OF THE EYE, EAR, NOSE AND THROAT

EPISCOPAL HOSPITAL

Monday

FREDERICK KRAUSS--2. Eye clinic.
W. R. WATSON—2. Ear, nose and throat clinic.

Tuesday

HAROLD VON GOLDBERG—2. Eye clinic.

Wednesday

W. R. WATSON—1:30. Ear, nose and throat clinic.
A. G. FEWELL—3. Eye clinic.

Thursday

C. C. BIEDERT—1:30. Ear, nose and throat clinic.
FREDERICK KRAUSS—1:30. Eye clinic.

Friday

C. C. BIEDERT—1:30. Ear, nose and throat clinic.
HAROLD VON GOLDBERG—1:30. Eye clinic.

TEMPLE UNIVERSITY HOSPITAL

Monday

MATTHEW ERSNER—3. Operative otology.

Tuesday

CHEVALIER JACKSON and associates—8:30. Bronchoscopic clinic.
ROBERT RIDPATH—2. Laryngological clinic.
LUTHER C. PETER—3. Operative ophthalmology.

Wednesday

CHEVALIER JACKSON and associates—8:30. Bronchoscopic clinic.

Thursday

CHEVALIER JACKSON and associates—8:30. Bronchoscopic clinic.
ROBERT RIDPATH—2. Operative laryngology.
LUTHER C. PETER—4. Ophthalmological surgery.

Friday

CHEVALIER JACKSON—8:30. Bronchoscopic clinic.
MATTHEW ERSNER—4. Otological clinic.

ST. MARY'S HOSPITAL

Tuesday

WILLIAM GRADY—3. Otolaryngology.

Wednesday

F. A. MURPHY—3. Ophthalmology.

Thursday

R. T. M. DONNELLY—3. Ophthalmology.
EDWARD MURPHY—3. Otolaryngology.

JEWISH HOSPITAL

Wednesday

J. C. KNIPE—3. Ophthalmological operations.

Thursday

A. S. KAUFMAN and R. F. RIDPATH—2. Otolaryngological operations.

LANKENAU HOSPITAL

Monday

W. J. CREIGHTON and DR. SMITH—1. Eye clinic.

Tuesday

W. J. CREIGHTON and DR. SMITH—1. Eye clinic.
RALPH BUTLER and J. A. BABBITT—2. Ear, nose and throat clinic.

Wednesday

W. J. CREIGHTON and DR. SMITH—1. Eye clinic.

Friday

W. J. CREIGHTON and DR. SMITH—1. Eye clinic.
RALPH BUTLER and J. A. BABBITT—2. Ear, nose and throat clinic.

JEFFERSON HOSPITAL

Tuesday

LOUIS H. CLERF and staff—9. Bronchoscopy.
F. O. LEWIS and staff—9. Nose and throat operations.

Wednesday

F. O. LEWIS and staff—10. Carcinoma of larynx.
LOUIS H. CLERF and staff—11. Bronchoscopy.

Thursday

LOUIS H. CLERF and staff—9. Bronchoscopy.
F. O. LEWIS and staff—9. Nose and throat operations.

Friday

C. E. G. SHANNON and staff—3. Ophthalmology.

PRESBYTERIAN HOSPITAL

Monday

H. M. LANGDON and J. M. THORINGTON—2. Ophthalmology.

Friday

N. P. STAUFFER, W. CARISS and O. R. KLINE—2. Otolaryngological operations.

WOMAN'S MEDICAL COLLEGE HOSPITAL

Tuesday

MARGARET F. BUTLER—2. Ear, nose and throat clinic.

Friday

MARGARET F. BUTLER—2. Ear, nose and throat clinic.

WOMAN'S SOUTHERN HOMEOPATHIC HOSPITAL

Thursday

GILBERT J. PALEN, CARROLL HAINES, H. BAILEY CHALFONT and EVERETT A. TYLER—2. Tonsillectomy and adenoidectomy clinic, adults and children under gas anæsthesia.

WOMAN'S HOMEOPATHIC HOSPITAL

Thursday

JOSEPH V. F. CLAY, J. R. CRISWELL, and CHARLES J. V. FRIES, JR.—9. Nose and throat clinic.

MISERICORDIA HOSPITAL

Monday

J. E. LOFTUS—2. Otolaryngological operations.

Tuesday

C. T. MCCARTHY—2. Otolaryngological operations.

Wednesday

J. E. LOFTUS—2. Otolaryngological operations.

Thursday

C. T. MCCARTHY—2. Otolaryngological operations.

Friday

J. E. LOFTUS—2. Otolaryngological operations.

ST. CHRISTOPHER'S HOSPITAL

Monday

H. J. WILLIAMS or E. H. CAMPBELL—1:30. Nose and throat clinic.

Wednesday

H. J. WILLIAMS or E. H. CAMPBELL—9. Nose and throat clinic.

Thursday

DR. FELDMAN—10. Eye clinic.

Friday

H. J. WILLIAMS or E. H. CAMPBELL—1:30. Nose and throat clinic.

HAHNEMANN HOSPITAL

Tuesday

H. S. WEAVER and staff—2. Ear, nose and throat clinic.

Thursday

H. S. WEAVER and staff—2. Ear, nose and throat clinic.

Friday

FRANK NAGLE and FRED PETERS—9. Cataract operations.

COOPER HOSPITAL

(Camden)

Tuesday

A. M. ELWELL—2. Otolaryngological operations.

Thursday

A. M. ELWELL—2. Otolaryngological operations.

MT. SINAI HOSPITAL

Monday

C. W. LEFEVER—3:30. Eye clinic, operations and demonstration of cases.

Tuesday

LEWIS FISHER—1. Ear, nose and throat clinic, operations and demonstration of cases.

Wednesday

DAVID HUSIK—2:30. Ear, nose and throat clinic.
GABRIEL TUCKER—4. Bronchoscopy.

Thursday

MORRIS WEINSTEIN—2. Ear, nose and throat clinic, operations and demonstration of cases.

Friday

MATTHEW ERSNER—1. Ear, nose and throat clinic, operations and demonstration of cases.

ST. JOSEPH'S HOSPITAL

Tuesday

GEORGE MORLEY MARSHALL—9. The Marshall operation for nasal deformity with end results.
A. J. KEENAN—3. Otolaryngological operations.

Wednesday

ARTHUR WRIGLEY—9. Otolaryngological operations.

Thursday

GEORGE MORLEY MARSHALL—9. The radical mastoid with end results.
C. T. MCCARTHY—2. Otolaryngological operations.

Friday

FRANCIS V. GOWEN—9. Otolaryngological operations.

UNIVERSITY HOSPITAL

Wednesday

GEORGE FETTEROLF and staff—2. Otolaryngological clinic, operations and demonstration of cases.

Friday

GEORGE FETTEROLF and staff—2. Otolaryngological clinic, operations and demonstration of cases.
T. B. HOLLOWAY—4. Ophthalmological clinic.

NORTHWESTERN GENERAL HOSPITAL

Tuesday

M. S. ERSNER, H. S. WIEDER and M. A. ZACKS—2. Nose and throat clinic.

Thursday

M. S. ERSNER, H. S. WIEDER and M. A. ZACKS—2. Nose and throat clinic.
S. H. BROWN—3. Eye clinic.

PHILADELPHIA GENERAL HOSPITAL

Tuesday

ROBERT J. HUNTER—2. Laryngology.

Friday

L. WALLER DEICHLER—9. Ophthalmology.

CHESTNUT HILL HOSPITAL

Tuesday

JOHN R. DAVIES—1. Ear, nose and throat clinic.

Wednesday

BENJAMIN D. PARISH—1:30. Ear, nose and throat clinic.

Thursday

JOHN R. DAVIES—1. Ear, nose and throat clinic.
CARL WILLIAMS—2. Ophthalmology.

Friday

BENJAMIN PARISH—1:30. Ear, nose and throat clinic.

GRADUATE HOSPITAL

Monday

R. BUTLER, G. M. COATES, S. R. SKILLERN, G. B. WOOD and E. B. GLEASON—2. Ear, nose and throat clinic.

Tuesday

R. BUTLER, G. M. COATES, S. R. SKILLERN, G. B. WOOD and E. B. GLEASON—2. Ear, nose and throat clinic; demonstration of cases of intercostal neuralgia.

FRANKFORD HOSPITAL

Tuesday

FRANK EMBERY and ROBERT WATT—2. Ear, nose and throat clinic.

Wednesday

WILLIAM H. CHANDLEE—2. Eye clinic.
DR. RICHARDSON—2. Ear, nose and throat clinic.

ST. LUKE'S AND CHILDREN'S HOMEOPATHIC HOSPITAL

Tuesday

CHARLES B. HOLLIS and staff—9. Ear, nose and throat clinic.

STETSON HOSPITAL

Thursday

CARLE LEE FELT—12. Ear, nose and throat clinic.

ST. AGNES HOSPITAL

Tuesday

BENJAMIN D. PARISH—1. Ear, nose and throat clinic.

Wednesday

GEORGE F. J. KELLY—2:30. Ophthalmological clinic.

CHILDREN'S HOSPITAL

JAMES A. BABBITT and associates. Nose and throat clinic.
EDWARD SHUMWAY. Eye clinic.

WILLS EYE HOSPITAL

STAFF—2, daily. Ophthalmological clinics, operations and demonstration of cases.

NORTHEASTERN HOSPITAL

Wednesday

GEORGE E. SHAFFER—2. Sinus disease.
G. A. LAWRENCE—3. Ophthalmology.